CHILD DEVELOPMENT

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DEVELOPMENT OF THOUGHT

BUFORD JOHNSON[1]

A genetic study of thought processes would include consideration of the majority of the responses of the young child during the period he is not sleeping. Since adequate verbal responses are more slowly acquired than many other forms of response that give evidence of thinking the data on the early development of the thinking process are relatively few. This lack in experimental studies is probably basic to the opposing viewpoints on thought in the child.

The contrast in viewpoints of those working in the field of child psychology is not so sharp as often appears. It is a difference in reference to the stages of development in thought. Piaget (7) is the outstanding exception through his assumption that the syllogistic form of verbalized responses is essential as evidence of conceptual thinking. He does not deny that the thinking process develops by stages from early years. He does assume that thinking is identified with verbal ability and that children do not attain the adult stage of conceptual thinking before the age of nine or ten years. He also implies that syllogistic thinking is typical of adults.

Other investigators consider the thinking process as developing from the earliest years, the stages attained depending to a great extent upon the experiences of the child. They also recognize the inadequacy of verbal responses and many techniques employed in study of thought utilize other forms of response.

Comparisons of the child with the adult in thinking cannot be conclusive from results for the same situation. To present situations equivalent with reference to previous experiences is practically impossible. It is possible to study the behavior of both groups when unfamiliar problems are presented. A comparative study of results obtained for children and adults under conditions that are certainly, in part, unfamiliar to both groups points up the developmental process of thinking.

It is admitted that the development of associative reactions or conditioned responses, and the development of discriminative abilities play a great part in the thinking of the child. In the following analysis the so-called higher thought processes are considered. Studies of the formation of concepts in early childhood and the function of conceptual thinking in the solution of problems have been increasing. The data will be analyzed with reference to the forms of responses made.

Among other definitions in Warren's Dictionary of Psychology, *concept* is defined as: A mental state or process which refers: (1) to more than one object or experience; (2) to one object in relation to others; when it represents a common aspect or attribute of the class it is an abstract idea.

Generalization is defined as; the process of perceiving or conceiving a general characteristic or meaning in things--responding to common aspects of specific elements in a complex situation. It is not required that evidence of a concept or of generalization shall be limited to verbal behavior.

Studies of the ability of the child to discriminate form *per se* - shape, some would say - independent of size, type of form, rotation or background have been made by Skeels (8), Gellerman (3) and Munn and Steining (6). Gellerman concluded that two-year-old children could discriminate form, in his study, triangularity, *per se*. The results of the other investigations confirm his conclusions. It is interesting to note the points of confusion for the children. When the form to which the child must respond in order to succeed differed but little from the other or negative form presented, confusion arose. When a trapezoid became almost a triangle, the tip differing from the triangle only by 1/8 of an inch, the children failed though they succeeded with a difference of 1/4 of an inch.

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[1] The Johns Hopkins University.

These children exhibited symbolic behavior in the form of gestures. The head was moved, when the triangles were inverted or rotated, in a seeming attempt to look at the form in the upright form as previously presented. Speech occurred including words associated with triangles. Some children also formulated the problem verbally and in absence of instructions formulated verbally their own instructions.

Studies of the development of concepts of magnitude, of distance, and of classes with respect to common aspects or attributes show that a stable concept is attained by degrees. Few two-year-olds attain the criterion of success set by the experimenters yet many make more than 50 per cent correct responses. Some four- and five-year-olds make as few as 5 per cent correct responses. This is clearly shown in the summary from the studies on the concept of magnitude by Thrum (10) and by Hicks and Stewart (2). Both studied the concept of intermediacy in size, called middle-size, but Thrum also included the development of concepts of big and little. Hicks and Stewart gave a preliminary training in teaching the meaning of the term middle-size. A tabular summary of results is given in Table 1.

TABLE 1

CONCEPT OF MAGNITUDE, CONCEPT OF MIDDLE SIZE

Age (Years)	Hicks and Stewart		Thrum	
	No. of subjects	Per cent successful No errors.	No. of subjects	Per cent successful No errors.
2	10	10	9	0
3	10	80	16	22.2
4	10	70	9	25
5	10	60		

The number making no errors is not representative of the stages of development of the concept. This is shown in Table 2 giving the percentage of correct responses for all choices.

TABLE 2

PERCENTAGE CORRECT RESPONSES. (Thrum)

Age (Years)	No. of subjects	Total	Percentages		
			Big	Little	Middle-size
2	9	53	62.9	74	21.5
3	16	79.9	97.7	98.4	62.1
4	9	91.2	97.1	97.8	79.3

The number of correct choices tends to increase from age two to age five years, with the greatest increase from age two to age three years. The differences in percentages in the two studies is probably due to the method employed, as Thrum gave no training to develop meanings of middle-sized and employed a greater number of steps or varied series. Only one two-year-old of the 19 included in both studies attained the standard for success. Thrum found that the concepts of big and little were well developed at each age, 10 or 62 per cent of the three-year-olds making no errors. The concept of middle size was slower to develop and more stable at age four. Six children of the 35 made no errors in any choice.

The influence of experience was manifested in the decrease in errors after initial trials in the series. Hicks and Stewart found that 60 per cent of the errors made were in Series 1. Gellerman found similar results in perception of triangularity. Until a child is confronted with a situation demanding the perception of relative size or form there is confusion in setting an objective in his response. Children often set objectives for themselves. This is illustrated by responses made in a study in progress by Kagy (4) on development of concepts which required selection of objects on basis of common attributes. The classifications included: Two-legged and four-legged animals; Ground objects; Water objects; Air objects. The child selected a picture of an object and placed it in either one of two boxes. No reference to the basis of selection was given. Each series of 10 cards presented included 5 cards having no relation to the classification problem. Records were kept of the verbal responses accompanying the placements.

The range of ages was 30 to 114 months. The percentage of correct responses for all series is given in Table 3.

TABLE 3

AGE DIFFERENCES IN PERCENTAGE OF CORRECT CLASSIFICATIONS. (From Kagy)

Age (Months)	No. of subjects	Percentage correct of total of 40 selections
30-41	6	8
42-53	15	27
54-65	7	61
66-77	9	73
78-89	11	75
90-101	12	80
102-114	4	94

The results show a beginning comprehension of classification by common characteristics at the age of 3 years and a rapid increase from 4 to 5 years of age. The concepts are well stabilized for the majority of children from 5 years upward.

The objective of the child in his placements are illustrated by the verbal responses. In presentations of land and water and air objects in varying combinations other classes were made as the following remarks indicate.

3 years, 6 months. Man riding on tractor, Woman riding in cart, with wheels; without wheels.

4 years, 6 months. Things to ride in. All things not in water. With wheels--go fast.

5 years, 6 months. All pull something. Some wheel and some have feet.

6 years, 6 months. I put riding pictures together. All people on ground together. All wheels but little boy--He has legs instead of wheel. Numbering began at this age as, "2 and 4 go together".

7 years, 6 months. All something to ride in. All things that move. All have engines.

In the classification of animals with reference to two or four legs, the following illustrations show a variety of common aspects perceived in forming classes:

3 years, 6 months. Teeth to bite and eat.
4 years, 6 months. Large long necks; Large ones together.
5 years, 6 months. All birds; elephant so slow like an ostrich. All big like deer.
6 years, 6 months. There were little and there were big.
7 years, 6 months. Deer runs fast--so can girl if she wants to. Not birds and humans but animals. Duck family.

Several children classified by feathers or fur commenting upon the reason for choice. When human figures were to be placed a problem arose. In solving it the two-legged class was made. In a series to be classified according to water objects in contrast with land objects the picture of a woman swimming was included. Hesitancy arose and the child said: But she goes on land too. A child's interpretations are often valid and the response correct according to his objective.

In studies of problem solving it has been observed that the stages of solution are similar for children and adults. Gellerman (3) concluded from his work with the Double Alternation Problem that the human subjects, adults and children, exhibited the same general stages of learning as did the monkey. Though the human subjects performed more successfully and could extend the problem to a series of greater length the stages in learning were similar. The ranges of trials required for success showed marked overlapping in age from 6 years to 23 years of age. Two children 3 and 4 years of age became tired of the problem and were excluded.

Matheson's (5) study of Problem Solving behavior in children from 2 to 4-1/2 years old also showed that at the ages under three years solution was not attained, the child often making no response to the unfamiliar setting. At age four, 62 per cent were successful. The verbalizations give interesting evidence of the child's thinking. There were cases in which the child used or suggested other solutions than the methods provided. In illustration: If there was only a block here then I could step. Maybe I can get a chair.

One child climbed over the railing. Another who failed was asked: How do you suppose Bobbie got the cookie? He explained in such a way as to give evidence of knowledge of solution but said "I can't do it."

Hazlitt (1) tested children and adults on the ability to make exceptions. She found no real difference between the thought processes of the child and of non-scientific adults. The stages of thought in making an exception are of interest. The child makes it practically but is unable to formulate it; at the next stage he formulates it but does not use the word "except"; by the age of seven years the word "except" is spontaneously given. This difficulty in verbalization of the thought is characteristic of the young child. A similar difficulty occurs with adults in response to unfamiliar situations.

Donald Snygg (9) in a study of the relative difficulty of mechanically equivalent tasks offered an opportunity to 88 college students to discover a principle for cancellation of figures. Forty reported the principle of "cancel all figures with curved lines" and were superior in time of performance; 21 used the concept "three circles, an oval, and a do-funny", and were intermediate in performance; 27 reported no principle. Of this last group only 1 subject was able to perform the task as quickly as the average time for the group deriving the principle. Snygg also found that sixth grade children and graduate students having discovered a principle in one task were able to carry the method over to new tasks. In the task of completing series of numbers there were marked differences among the graduate students in time required and in relationships recognized.

After presenting the number series used by Snygg to 11 graduate students in psychology, I presented another series for which algebraic formulae offered a principle of completion. Instructions and the series given were as follows:

> You are to be given a number series to complete. At the end of each series three or four lines will be found. You are to place a number on each line to complete the series in accordance with a principle underlying the order of the series.

Number of Series	Number Series										
I	1	1	2	6	24	120	720	___	___	___	
II	54	6	40	5	28	4	18	___	___	___	
III	4	12	9	9	24	16	16	___	___	___	
IV	9	25	34	16	36	52	25	___	___	___	___
V	8	36	54	27	27	108	144	___	___	___	___

Results of the number series list are given in Table 4.

TABLE 4

RESULTS FOR NUMBER SERIES

Individual	Series Three items per test			Four items per test		Number of series correct
	I	II	III	IV	V	
	Number of items correct					
a	3	1	0	0	0	1
b	3	0	2	1	0	1
c	3	3	2	0	0	2
d	3	3	0	4	0	3
e	3	2	0	4	0	2
f	3	3	2	2	2	2
g	3	3	2	3	0	2
h	3	3	2	4	0	3
i	3	3	0	0	0	2
j	3	3	2	3	0	2
k	3	3	2	4	2	3
All individuals Number of series correct	11	8	0	4	0	23

It was apparent from the records that trial and error methods were frequently used for each number to be placed. Many failed to formulate a principle and few changes in procedure from problem to problem were made by an individual. The simpler problems for which arithmetical analysis was evident were more readily solved. All failed on the final series.

After completion of the series the papers were collected and a similar blank given with the request to write in algebraic form the principle of completion employed. Some indicated that no formula was derived originally. In some cases a new formula was written and in other cases a formula was given that was faulty in comparison with their own solutions. Percentages of incorrect formulae ranged from 22 for one series to 66 for another.

An ingenuity problem, illustrated in Figures 1, 2, and 3, was given to eight of this graduate group and to ten undergraduates in a class in psychology. In Figure 1 is shown a cube on which the faces are lettered (a front, b left, c back, d right, e top, and f bottom) and which has been cut in sections. In the illustration it is set on face f. The students were asked to mark the cubes in Figures 2 and 3 so as to show the sections as they would appear if the cube illustrated in Figure 1 were: (2) set on face d, (3) set on face e. The results are given in Table 5.

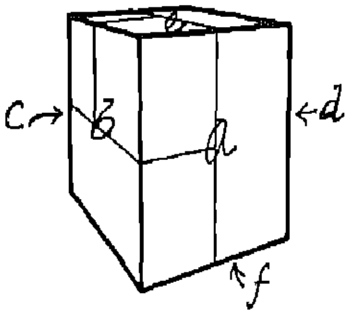

Fig. 1

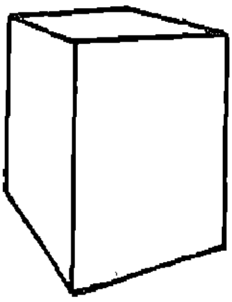

Fig. 2

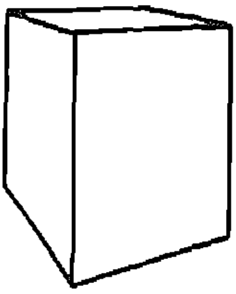

Fig. 3

TABLE 5

RESULTS FOR ROTATED CUBE TEST (Percent correct)

Individual	Figure 2	Figure 3	Individual	Figure 2	Figure 3
	Graduate Group			Undergraduate Group	
a	80	40	1	100	100
b	omitted	omitted	2	80	40
d	80	40	3	100	60
e	80	40	4	80	0
g	100	100	5	60	0
h	80	100	6	100	100
i	100	100	7	omitted	omitted
k	omitted	omitted	8	100	100
			9	80	40
			10	100	omitted

The mistakes made by both groups are similar despite the experience of the graduate group with varied tests and experiments. Faces were usually marked correctly. Errors and omissions occurred in marking lines for sections. Drawings on the sheets given showed many trials without a preceding formulation of the problem and attempts at marking sections without recognition of rotating effects.

The comparative analysis of the conceptual thinking of children and adults in unfamiliar situations shows similarity in individual differences in selection of procedure. This procedure is determined in part by previous experiences in development of concepts and in application of principles to solution of problems. The studies of children give evidence of the early development of concepts and the ability to respond to the relative differences or similarities in situations presented. The implications of these studies point up the importance of providing experiences for the child that offer advantageous conditions for development of thought. It is evident that many adults have not developed their potentialities in thought. The child is less hide-bound by traditional forms of response. The procedure selected as in classifying according to a common characteristic often differs from the conventional adult objective. In unfamiliar situations the adult often reverts to habitual forms of response which are repeated though previously found unsatisfactory. With repetition more logical modes of attack are made. The less circumscribed responses of the child based on a principle in selection should be conserved. It is important that experiences be provided that give the opportunity for and motivate toward the development of thought.

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A STUDY IN INFANT DEVELOPMENT

ALMA FRANK

The interest which led to this study arose from observing, over a period of years, a gradual diminishing of well-coordinated movement in young children. The children were attending nursery groups in progressive schools. At the age of two, when they entered school, they apparently possessed a degree of physical coordination which by the end of the third year had notably diminished; by the end of the fourth year this coordination had given way to definite well-established postural habits - rigidly fixed positions of certain parts of the body. These habits inspire the question: Is their presence related, as it seems to be, to the disappearance of the smooth and harmonious flow of movement which the two-year-olds possessed?

A recent study (4) of posture in the young child, directed by Billie L. Crook, physiotherapy supervisor for the crippled children's division of the State Department of Education of Texas, presents excellent illustrations of these postural habits. The majority of the children came from homes of university faculty members. The total number of children were divided for study into groups according to sex and age. The following quotations are taken from the study:[1]

> "To summarize points of contrast, we might say, the head of the two-year-old child is still erect; the head of the three-to-five-year-old is usually forward; the scapulae of the two-year-old lie flat on his back. The scapulae of the three-to-five-year-old are usually winged; at two years the sacral angle is very slight; at three to five it is increasing markedly; the abdomen of the two-year-old is prominent, but not often accompanied by other postural faults; the prominent abdomen of the three-to-five-year-old is accompanied by other postural faults; the knees of the two-year-old are held easily and normally; the knees of the three-to-five-year-old are usually pushed back or hyper-extended to maintain the balance of the protruding abdomen; it is impossible to judge posture while the child is clothed.
>
> "The best postures were found among the two-year-old children and the worst posture in their group was as good as the average in the other groups.
>
> "From our study the indication seems to be that the poor alignment becomes more pronounced as the child grows older.
>
> "The question now resolves itself into this one problem: Can we prevent the development of these postural faults of the four-year-old by starting with the child when he begins to walk? Could we not teach him to walk without thrusting his knees backward? Could we help him to relax his tight hip-flexors by exercises and games directed toward this end? Could we teach him to keep his weight forward and avoid the stretching strain put on the ham strings by a back-knee position?"

Such questions involve problems of time and technique, fundamental problems in education. The point of view, however, from which they are being attacked today by leading educators indicates a more fruitful conception than is implicit in the framing of the above questions.

This broader conception is presented by William Heard Kilpatrick, Professor of Education, Columbia University (9). In his paper,[2] which contains such sub-titles as "The Work of Science," "The Nature of Behavior," "Principles of Learning," he writes:

> "Still further, not only is the whole organism thus involved in each

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[1] Permission granted by author to quote and to reproduce silhouettes from this study.

[2] Permission granted by Teachers College, Bureau of Publications to quote from this paper.

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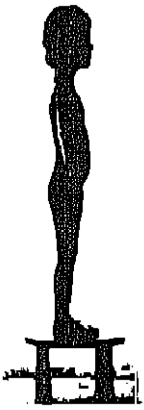

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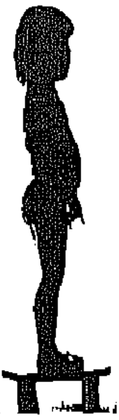

Fig. 2

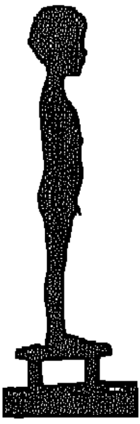

Fig. 3

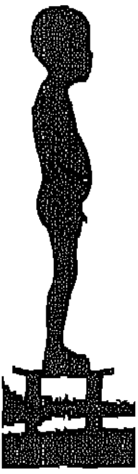

Fig. 4

Groups I and II
Girls and Boys
2-1/2 Years Old

Groups III and IV
Girls and Boys
3-1/2 Years Old

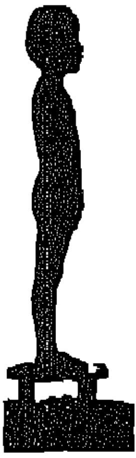

Fig. 5

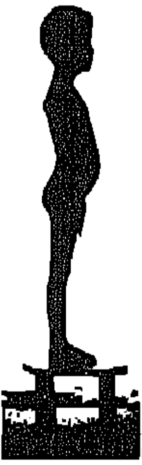

Fig. 6

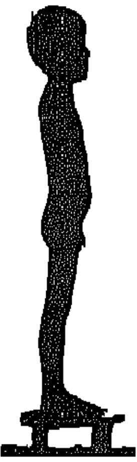

Fig. 7

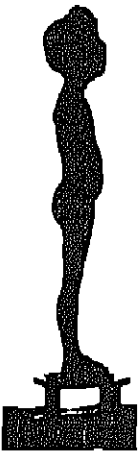

Fig. 8

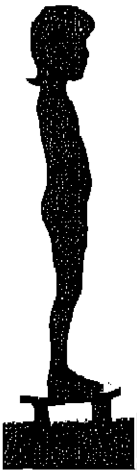

Fig. 9

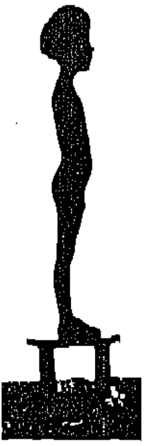

Fig. 10

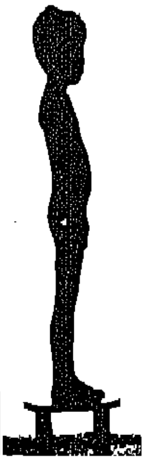

Fig. 11

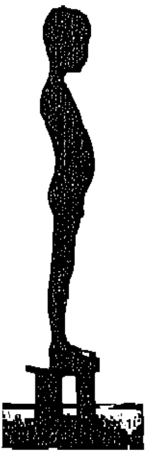

Fig. 12

Groups V and VI
Girls and Boys
4-1/2 Years Old

> learning experience, the environment also is involved. Indeed, the relationship between organism and environment is uniquely close. According to Haldane 'an organism and its environment are one, in the sense that though we can distinguish them we cannot separate them unaltered, and consequently cannot understand or investigate one apart from the rest'. These are *strong words, but they* appear to represent the trend of competent thought. Learning, from this consideration, joins the organism - here the human self - with the environment in a new and intimate fashion. Any organic activity is as much an affair of the environment as it is of the organism. Any habit of a child belongs as truly to the situation as to the child, for it joins both together. And 'the situation' is the actual total situation in all its particular manifestations to which the child is in fact sensitive. In a time sense, any significant instance of learning thus joins up in a way new for the child, indefinitely many parts of the situation at the same time that it remakes the child in indefinitely many aspects. Learning becomes thus immensely far-reaching and we see the more clearly how inadequate - nay, how hazardous - are those procedures and those studies which attempt to base themselves on single and isolated learnings. The whole child with all his effectual part now actually located in a present concrete situation with all its effectual connectedness - this is the only unit. Anything less is an abstraction, a part only. Conclusions based on such abstractions need not elsewhere be valid, and treatment proposed under such conditions may well be harmful. Difficult as are the demands herein made, we dare not disregard them."

This conception applied to the problem of the physical well-being of the child means a procedure vastly different from one which aims to teach the child a long list of isolated learnings such as not to thrust his knees backward, to relax his hip-flexors, etc. On the contrary, it means a careful survey of the situation which children, such as these represented in the silhouettes for instance, are meeting thus inadequately. To be specific, it means to what influences is postural control particularly susceptible and which of these facilitate maintenance of erect posture and which have an opposing effect? It means also what states of readiness for guidance do we find within the organisms whilst it assumes erectness and which form of guidance works best under which conditions?

"Under which conditions" is an exceedingly important factor. It is emphasized by Kilpatrick in the above-mentioned paper (section called "The Work of Science") as follows:

> "In science we study carefully the recurring sequences which nature presents: how stones fall, when water freezes and boils, how gases behave. Until recently, under the influence of Newtonian physics, the regularity of these sequences has unduly impressed the modern mind. It begins now to appear that we have in connection overlooked two things.
>
> "For one thing, these regularities are not as exact as once we thought; they seem rather to be statistical averages. For another, we formerly disregarded the "if" aspect of these sequences: if thus-and-such conditions prevail, then will such-and-such state of affairs follow. This "if" aspect may be, and often is, in our hands. If so, it is we who are to say whether the "thus-and-such" antecedent conditions are to prevail; and, under such conditions, it is we who thus bring about the "such-and-such" conclusions; or, as some would prefer, "nature" does it at our bidding. So conceived, these "laws of nature" present simply certain dependable expectations that we can within limits use to our ends. In this newer conception of science we thus get not a reign of law to bind us, but wider tools for extending our control. Through these we gain freedom, not lose it."

This conception represents a significant advance in education. Since its applicability rests upon observed facts in science, educators turn to the recent research on infant development for the solution of the problem with which this study is concerned.

Claude Bernard (2) has referred to some experiments as "groping experiments - experiments to see." Although he refers to experiments in physiology and therapeutics, the phrase "experiments to see" classifies the experiment presented in this report. The intention was "to see" the effects, if any, of induced positions and of support applied by the experimenter to maintain them, upon the infant's overt somatic behavior during the period of acquiring stance and locomotion.

In order to give this experiment its proper orientation, it is necessary to discuss briefly the assumptions and experimental procedures in investigation of infant behavior and behavior growth.

In outstanding studies we find statements to the effect that it is desirable but impossible to observe the whole child comprehensively. Gesell writes (6): "It is impossible to bring the whole child under comprehensive observation and yet his entire physique must of necessity be accounted for in a full description of the behavior flow."[3] He solves his dilemma in this fashion: Since the task of verbal description is difficult, it will be necessary to describe separately the behavior *patterns of different parts of the infant's body. Incidental comment* will be made to remind us that these parts do not function independently but always in some dynamic and genetic relationship with all other parts. It does not follow that this dynamic relationship between varied portions of the body is equally strong at all ages and at all moments, for there is continuous shifting in the whole pattern of tensions. We shall consider in order the head, arms, hands, trunk and legs, stressing the growth changes in behavior patterning throughout the gamut of age levels. The synthetic correlation of the developmental data in these varied subdivisions must be left largely to the reader.' (underscoring mine)

Dr. McGraw (11) also discusses the need to study "the whole child." She adopts a method which she describes as follows: "Systematic analyses of the changes as indicated in overt-somatic activity in the development of a behavior pattern from the time of origin until it attains maturity constitute both a feasible and a revealing method of studying the process of growth."

Both these writers adopt the method of observing growth by analyzing separately the "behavior patterns" of different parts of the body. Moreover, both admit that isolation of a behavior pattern is impossible but claim that within certain set experimental limits sufficient "behavior trends" appear to justify the acceptance of the resulting protocols as representative of growth processes. This amounts to another assumption, since there has been no attempt to test or prove the claim with comparable data from other types of experiments

Only one type of experiment has been done, and that involves the use of induced positions as a primary experimental procedure. "Standing behavior," for instance, has been observed with the infants lifted to and supported in "standing position" from the age of four weeks. "Sitting behavior" has been observed with infants who are either pulled up by the arms to "sitting position' or by other means placed in sitting position from the age of four weeks. The same method is practiced for observing "walking behavior". What we have, therefore, is observations of various "behaviors" "or behavior patterns," in organisms who have been placed in supine, prone, standing, supported standing, pulled-to-sitting, "passive induced sitting," and other positions.

In some instances one position remains constant throughout the observation of a single behavior. In other instances the initial position does not remain constant, one or more other positions being induced by the examiner.

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[3] Permission granted by the author to quote from "Infant Behavior".

This use of imposed position is exemplified by Gesell in his chapter "The Growth of Posture" in "Infant Behavior." He writes:

> "The Second Quarter (16 to 24 weeks) Sixteen weeks marks many transitions. The infant in the second quarter becomes a propped-up as well as a supine individual ....
>
> "The Third Quarter (28 to 36 weeks) From the standpoint of postural self-dependence, this is a transitional period. For the most part he still needs props, safe-guards, and help.
>
> "The Fourth Quarter (40 to 52 weeks) The adult hands which had to aid his balance at 40 weeks are now withdrawn."

The causal relation in these experiments between the imposed position and the "need" for "props" and for "adult hands which had to aid his balance" is obvious. The reason for the need of the "props" is that the infant's position is imposed. The underlying assumption is either that the infant must inevitably be placed and supported in certain positions during postural growth or, that growth of a behavior, one aspect of which at the time of maturity of the pattern is a certain position, can be observed only while the infant is placed by the adult in this position.

With the exception of supine and prone, the positions used in these observations all require support from the examiner. The organism in some instances is supported by means of suspension, the point of support being the thorax; in other instances, by means of a combination of suspension and flat static surface; sometimes by mechanical means such as a belt and chair, the points of support being the abdomen and the back; sometimes by a flat static surface only, the point of support being the feet. This means that at various points upon the organism varying degrees of pressure or traction are supplied by the experimenter.

These facts give rise to the question: Are the responses which are possible under the particular limits set by these experimenters adequate to the vital process presumably being observed? Are these responses the spontaneous and free manifestations of growth?

In order to answer this question, an analysis of the responses must be made.

That behavior such as standing, sitting and walking is inseparable from postural activity is an accepted fact. That postural activity is enacted through the medium of neuro-muscular mechanisms and that the working of neuro-muscular mechanisms is influenced extensively by tactile stimulation and pressures upon the peripheral sensory end-organs and by stimulation of the proprioceptors arising from movement of the limbs, has been established by the experiments of outstanding physiologists. The work in this field has been well summarized by Rudolph Magnus (10) and by Charles Sherrington (12).

Unless nervous action in man is of a different order from that in the higher animals (and observed facts do not bear this out) (8) the configura-

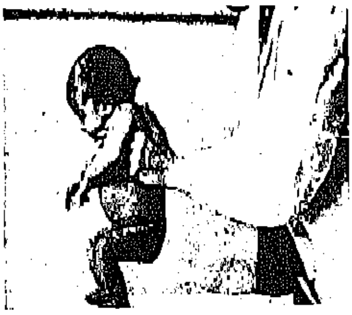
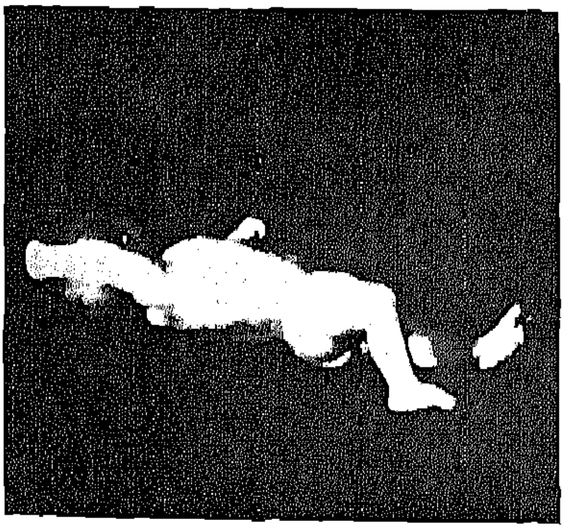


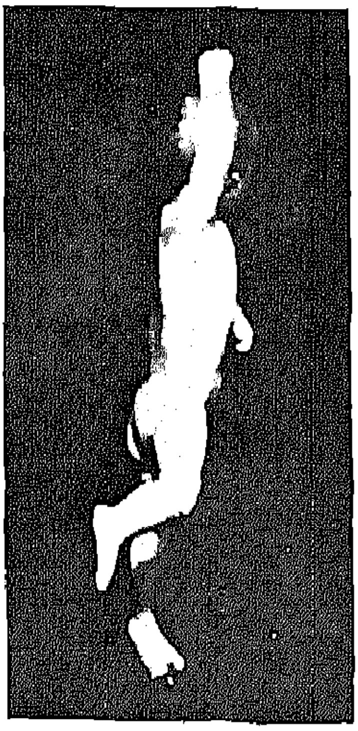
Fig. 13. Standing Behavior. 4 weeks.

tion in Figure 13, (6-taken from page 85) for instance, represents not only manifestations of the growth process but also responses to the suspended position. The sagging of the head, *the particular-posturing of the arms; to what* extent are these due to pressures exerted by adult hands? We can ascertain this only by comparing the behavior of the infant under these pressures with its behavior when these pressures are reduced to the zero point, or to the lowest possible minimum.

The conditions and procedure in the following observations were arranged to make such a comparison possible. It was also hoped that the results, interpreted in the light of conceptions held by leading scientists and of observed facts in physiology, would suggest a method of research in infant development which will disprove the assumptions that the whole infant organism cannot be brought under comprehensive observation and that analyses of a behavior pattern, when *induced positions are part of the observed pattern, "constitute both* a feasible and a revealing method of studying the process of growth."

That the whole organism must be brought under comprehensive observation is actually implied in Gesell's definition of growth. He defines growth as a process which "organizes the individual." In relation to somatic behavior this can mean nothing less than action which embraces the working together of all the parts capable of responding at the time.





Figs. 14 and 15. Somatic Behavior at 4 weeks, looking at the same action from two points of view.

In this picture of a 26-day-old infant there is a certain organization of mechanisms, producing one total action configuration. In the picture of the infant (Gesell's) in standing position a similar organization does not appear. Parts which are capable of responding in the one are in the other prevented from free and spontaneous action. The difference in the dynamic relationship of the head and arms to the trunk is obvious; it is precisely the organization of the individual that is interfered with by the pressures on the thorax, axillae, and joints. If the protocols are to be representative of growth as growth is defined, the behavior of the part can be accurately observed only in the context of the total behavioral response indicative of organization.

EXPERIMENTAL MATERIALS AND METHODS

The subjects chosen for the research were living in the Home for Hebrew Infants, New York City. They were therefore of the same nationality and were receiving the same nutritional and routine care.

The home proved to be particularly advantageous for this study. Since Dr. Hess organized it and carried on research there, the infants have purposefully and consistently been unaided by adults in rolling, sitting, standing and walking. It was considered desirable to have infants who were not in their general routine life experiencing positions the effects of which were to be observed in the experimental situation.

The organization of the orphanage as a whole was also of advantage in that it provides markedly unhurried and cheerful surroundings. Each infant has a room of his own with vita-glass French door and windows opening upon an uncovered porch. The partitions of the rooms are of glass, making it possible for an infant to watch the nurses moving about as well as other infants in adjoining rooms. From day to day each nurse has the same four infants in her charge, and is requested to take time to play with them during the morning bath, which is given to each infant in his own room. The babies over four months old are brought together in the afternoon for a playtime on the floor of the reception room.

Two groups of infants were selected; one consisting of three six-months-old boys who were making efforts to roll from supine to prone, and the other consisting of three eight-months-old girls who were about to sit up while on the floor in the afternoons. These infants were all on the feeding used for normal infants and were either normal in weight or within a pound of it. Although no psychological tests were made, the babies selected were considered normal by the pediatrician.

The plan was to take moving pictures of these infants under the following two different experimental procedures, and to compare results.

> Procedure No. I. The infant placed upon its back and left without further stimulation by touch or sound from the examiner.
>
> Procedure No. II. The infant placed upon its back and then by the examiner drawn into a position which it could not itself assume without adult aid.

No lures were used in order to stimulate specific activities such as rolling or creeping. The toys the infants were using in their beds when taken from their own rooms to the examining room were carried along either by the infant, or the examiner. In the latter case, they were placed on the floor within easy reach of the child.

The photographs were always taken in the same room, which was used only for this purpose at the same time daily. The infants were taken one at a time into the examining room, undressed and placed on the floor. A blanket, mattress pad and a sheet of dark green flannel were used underneath and another sheet of flannel hung on the wall behind the infant.

In order to minimize the possibility of arousing fear reactions, the introduction of the infants to the photographing situation was gradual. Before being taken to the examining room at all, each infant had, during the previous week, spent a half hour a day on the floor of his own room. During the first week in the examining room they were not undressed, and it was only after three weeks of being on the floor daily (Saturdays and Sundays excepted) that they ceased regarding the room and the examiners and went about the activities they were accustomed to carry on in their own beds or on the floor in the afternoons. The flood-lamps were introduced during the fourth week; aside from blinking at first the infants paid no attention to them. Pictures were taken on the last day of the fourth week, and thereafter always on the last day of the week, since it was the farthest away from the break in the routine occurring on Saturdays and Sundays.

A Bell and Howell 16 millimeter camera was used.

Attempts were made to silence the camera. They were, however, unsuccessful, and the first films taken were so full of stops and starts that no flow of movement could be seen. A metronone, which served to drown the sound of the camera, was then used continuously in the room, and the speed of the camera was reduced from 64 to 48. After this adjustment the infants did not stop or, as far as could be seen, change their activities at the sound of the camera.

Each infant was left on the floor twenty minutes a day. The photographic lamps were put on for the last ten minutes of this time regardless of whether pictures were to be taken or not, in order to keep the set-up constant.

Due to limitations of time and equipment it was possible to employ only one induced position. It is to be regretted that others also could not have been investigated.

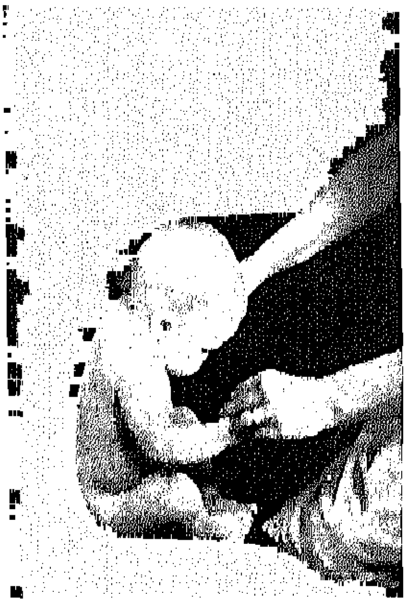
RESULTS

In presenting the results, there are a few simple comparisons to be made.

1. When the infant was placed on his back and left without further stimulation from the examiner (procedure I), the organism as a whole did not at any time while under observation take a course through space similar to the course taken under procedure II.

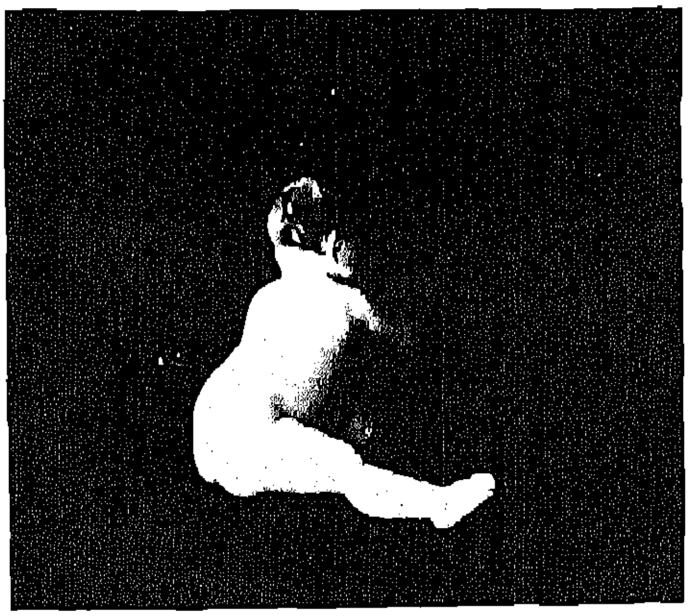
Under procedure I, the six-month infants kicked vigorously, rolled from supine to prone, or engaged in activities preliminary to rolling such as pelvic lifting, and twisting or rolling to one side and balancing there whilst swinging the upper leg back and forth horizontally. Obviously, during none of these activities did the organism move through space in a direction similar to the direction in which the infant is taken in Fig. 16.

Fig. 16. James: 6 months. Pulled to sitting by adult.
Procedure II.



The infants of eight months, even in the act of sitting, likewise moved in a direction different from their behavioral course under procedure II. They first rolled from supine to prone, then drew one leg under the pelvis, and starting from the lower back raised the trunk and head together, simultaneously drawing the leg out from under the pelvis gradually.

Figs. 17 and 18. Mary: 8 months. Attaining sitting without adult aid, Procedure I.



2. The structural configuration of the organism as a whole was different during all activities under procedure I from its structural configuration under procedure II. In both groups of infants the spine, under procedure II, was flexed to such a degree as to decrease the stature noticeably, both during the process and in the position maintained at the completion of the pulled-to-sitting activity. Neither in the process of an activity nor in any maintained position, did the infants, under Procedure I produce a similar posterior curve, thus decreasing the stature.

Fig. 19. Mary: 8 months. Sitting attained without adult aid.

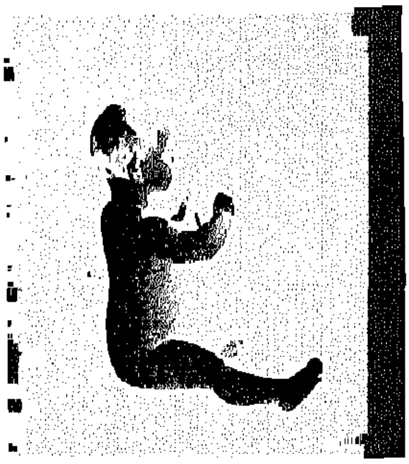
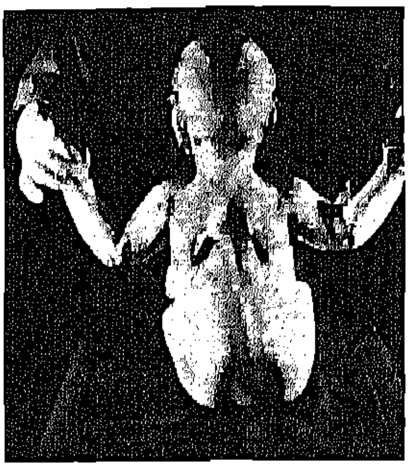


Fig. 20. Mary: Same day. Sitting as pulled-to-sitting by adult.



The drawing-in at the anterior thoracic region and the pushing down and outward of the abdominal region, both accompaniments of the posterior curve of the spine together with the decreasing of the stature, is shown in the following picture of James, a profile view taken at the same time as the picture next to it which shows him kicking vigorously.

Fig. 21. James: 6 months. Procedure I.

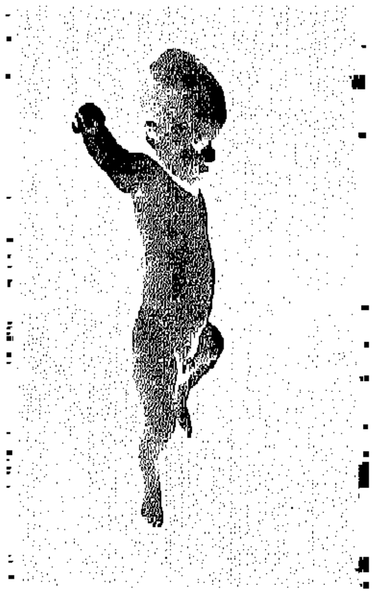
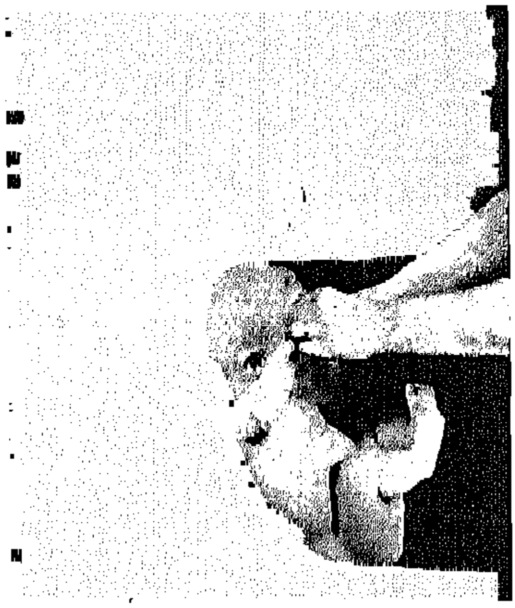


Fig. 22. Same; Procedure II.



3. There is a very conspicuous difference in the behavior of the muscles of the back. Under procedure I there is an even spread of contraction throughout the sacrospinales, and the back has an appearance of strength and ease. Under procedure II, contraction is apparently not taking place in the back muscles of the six month infants and in the older ones it is concentrated in the upper, middle, and lower trapezeus muscles and does not take place in the lumbar and thoracic portions of the sacrospinales, and the back has an appearance of strain.

Fig. 23. Marvin: 6 months.
First complete roll.
Procedure I.

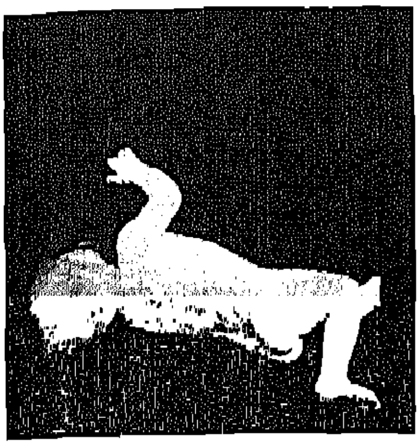


Fig. 24.

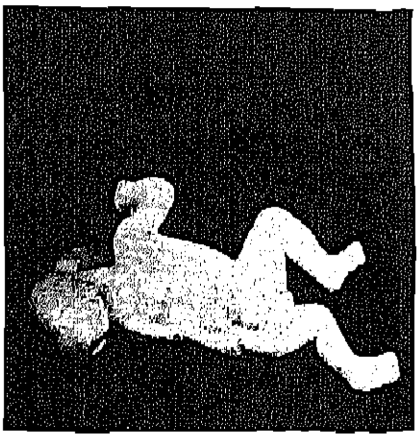


Fig. 25. Marvin: Same day. Pulled-to-sitting by adult.

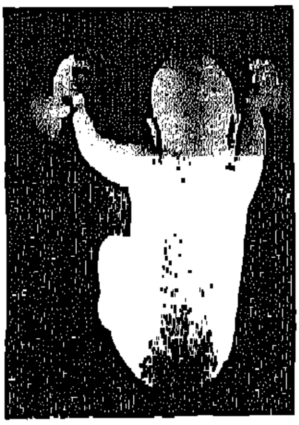


Fig. 26. Carol: 9 months.
Procedure I.

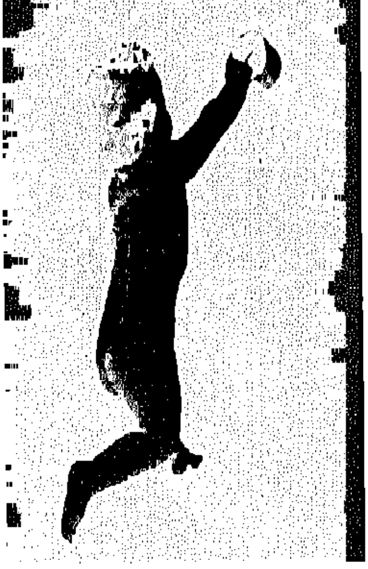


Fig. 27. Carol: Same day.
Procedure II.

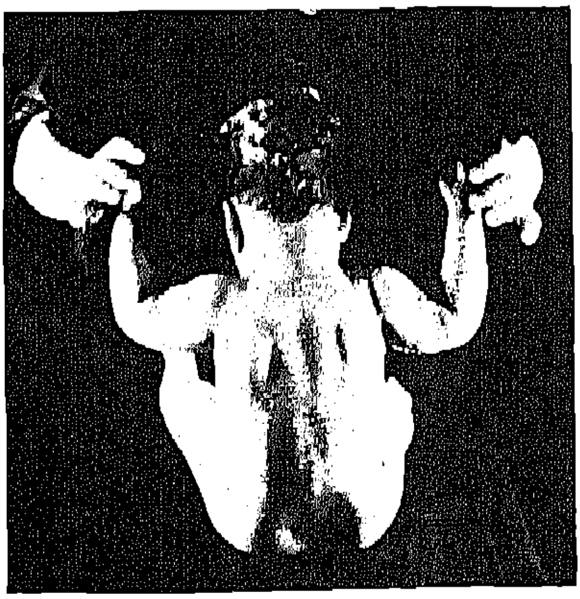


Fig. 28. James: 6 months. Procedure I.

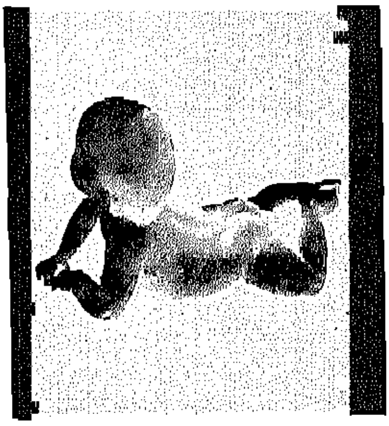
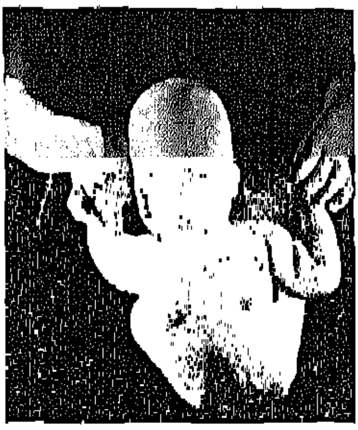


Fig. 29. James: Same day. Procedure II.



4. There is also a marked difference in the behavior of the segments in relation to the trunk and head.

In procedure II the legs are, as Gesell describes them, "helpless appendages." In Procedure I they perform an integral part of the whole movement. The difference in the behavior of the arms is quite obvious; in one case they are free to follow the head and trunk, whereas in the other, they are forced to move upward, drawing the trunk and head along after them.

5. Under procedure II, the head sags; under procedure I, it is usually extended when the spine is extended, and it never sags.

We may say, then, that the effects of the induced pulled-to-sitting position upon the somatic behavior of these infants occur in the direction in space taken by the organism, as a whole, in the structural configuration of the organism, in the relation of the parts to each other in use, and in the distribution of tension.

DISCUSSION

The effects pointed out above are overt manifestations apparent to the untrained eye. There are others less easily recognized. An approach to the latter can be made through the observations and resulting concepts of those experimenters who have worked intensively with neuromuscular mechanisms. Since somatic behavior and the working of neuromuscular mechanisms are inseparable, the interpretation of one must be made by means of an understanding of the other.

G. E. Coghill's (3) well-known work on Amblystoma gives us an exceedingly clear picture of the working of the mechanism in a simple organism. He concluded that behavior develops in Amblystoma by the expansion of a primarily integrated total pattern of action and the individuation of partial patterns within the total pattern. He also states that whether or not behavior in other vertebrates follows this plan of development has become a question of leading interest in the study of behavior.

Work similar to Coghill's has been done with the human fetus. In a review of the general responses of human fetuses as shown by Minkowski and others, Davenport Hooker (7) states: "The interpretation which I would give to the results of human fetal responses is, of course, quite clear. Every bit of evidence, from the work of Minkowski and from the other unfinished studies of which I have been speaking, indicates that the responses of human fetuses to tactile stimulation follow a Coghillian sequence; first, the expanding total pattern;

then, the rather rapid process of individuation of specific reflexes from that total pattern."

"The type of stimulation used in fetal work is of great significance. It may be remembered that Coghill used a human hair on Amblystoma embryos. Angulo used a coarse hair. Windle used metal and fiber needles, cactus spines, and other blunter instruments. Carmichael used many types of stimulators, but chiefly a metal or fiber needle, a coarse hair or a brush.

"I have recently been using a series of graded stimulators, human and horse hairs, which are just stiff enough to maintain, as they bend, a delicate chainomatic balance against weights of 10, 25, 50, or 100 mgm. .... Among others, Minkowski, in working with early human fetuses, has warned that rigid stimulators clearly cause direct muscle stimulation. In my opinion, 'weighted' esthesiometers, of the type mentioned, are the only proper method of applying stimulation to secure reflexes. .... After thirty years of embryological experimental work, it seems to me advisable to use stimulators which offer the least possibility of producing an unintentionally strong stimulus."

The significance of the results obtained by these men for experimental work on human infants lies in the implication that there exists in the infant organism as well a "primary mechanism of integration" and that the infant's somatic behavior follows the same plan of development as has been observed in Amblystoma and the human fetus. If this is the case, it becomes essential, in order to observe behavioral manifestations of the working of this mechanism, to heed Minkowski's warning to avoid direct muscle stimulation.

It is important at this point to call attention to the photographs in the section of this paper called "Results", - taken under procedure II. The direct stimulation of the shoulder girdle and arm muscles is obvious; some of the specific effects have been mentioned. It remains now, in connection with the above writings, to draw attention to the fact that the total behavior of the organism under procedure II is not a manifestation of the working of a "primary mechanism of integration." Unity is lacking. The behavior under procedure I, however, shows a comparative unity, which is in evidence in Figs. 30-32, as well as in all other pictures of the infants under procedure I.

Fig. 30

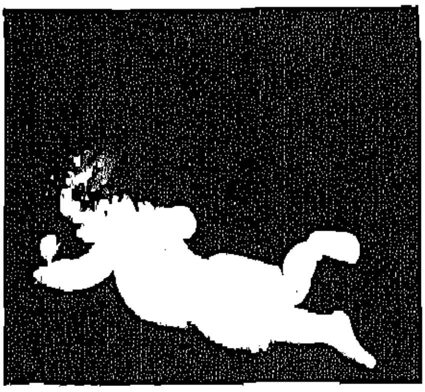


Fig. 31.

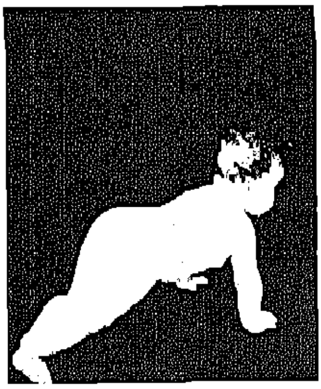
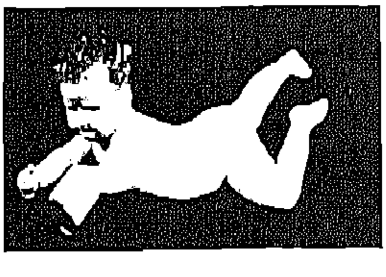
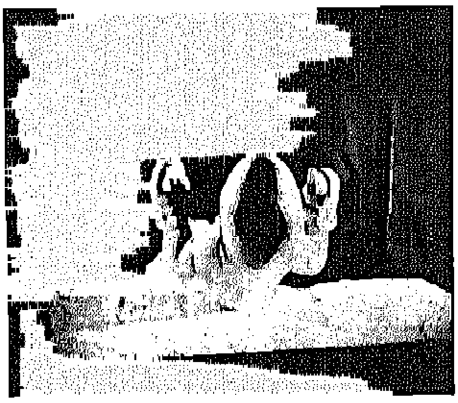


Fig. 32





Fig, 33

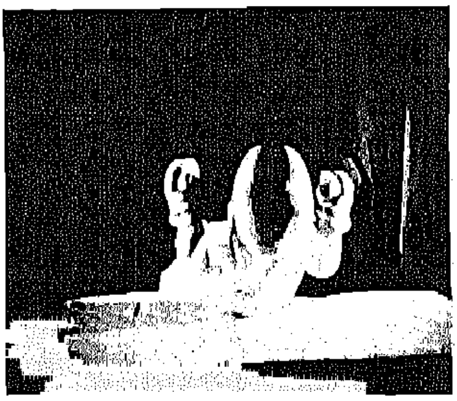


Fig. 34,

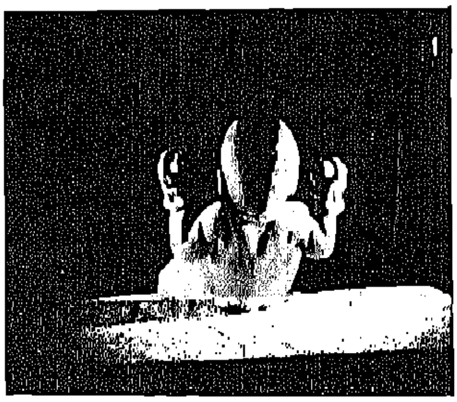


Fig. 35

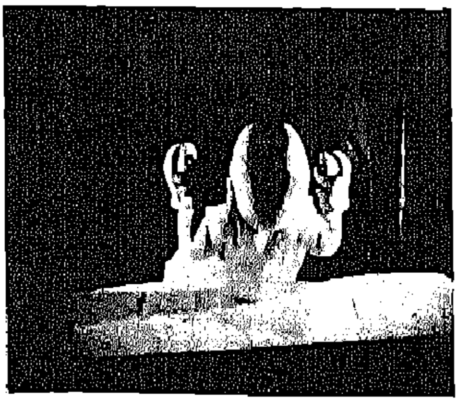


Fig. 36

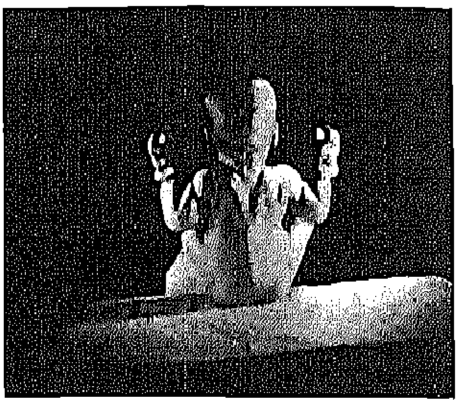
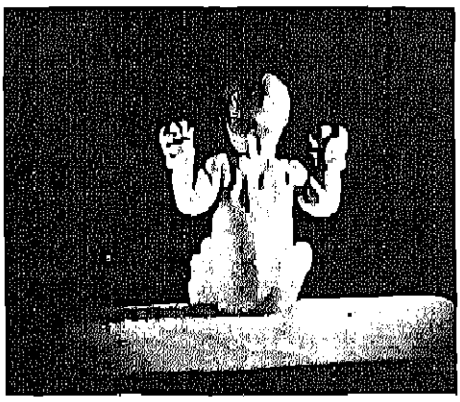


Fig. 37



Fig, 38

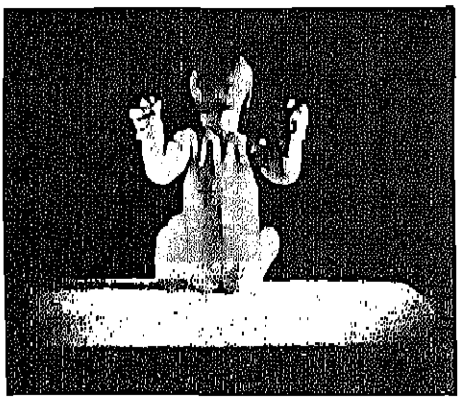
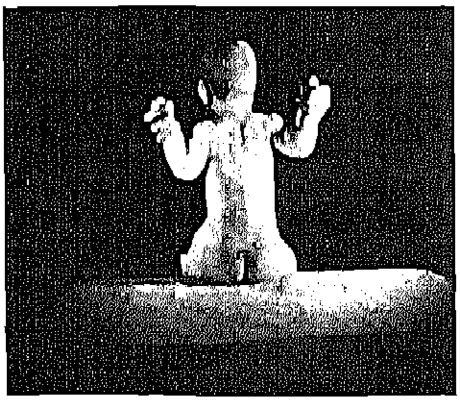


Fig. 39



Fig, 40

In regard to the relation between such unity and the mechanism of total integration, Coghill writes: ."The mechanism of total integration tends to maintain absolute unity and solidarity of the behavior pattern. The development of localized mechanism tends to disrupt unity and solidarity and to produce independent partial patterns of behavior. In the interests of the welfare of the organism as a whole, partial patterns must not attain complete independence of *action; they must be held under control by the mechanism of total integration.* Parts become integrated with each other because they are integral factors of a primarily integrated whole, and they remain integrated, and behavior is normal, so long as this wholeness is maintained. But the wholeness may be lost through a decline of the mechanism of total integration or through the hypertrophy of mechanisms of partial patterns."

With the above quotation in mind, let us look at Figs. 33-40, a series of photographs which illustrate, I believe, "partial patterns" of behavior produced as a result of work done upon the organism by the experimenter. That the infant's neurological mechanism will not of itself attempt a movement in the direction in which the organism is here being taken suggests that the directive force applied by the experimenter is bringing about this intense local contraction in the shoulder-girdle region, a development which will not take place whilst the integrating factor within the organism itself is permitted to function, and by means of its functioning to direct the behavior.. As has been pointed out, the infants in this experiment, left to their natural abilities, showed no such undue contractions, or tensions in spots.

The work of Sherrington and Magnus on reflexes is classic, and the results are now employed by the medical as well as the scientific world. Magnus, while working with higher vertebrates, happened upon a phenomenon which was of great interest to him and which led to definite conclusions concerning the relation of certain reflexes to postural activity. The brief description he gives of how he chanced upon the initial observation which led him on in a certain direction may prove a help to the reader in understanding the ultimate result. Magnus (10) writes: "The limbs of mammals, as of other vertebrates, are built up of bony segments, linked by a complicated arrangement of ligaments and moved and fixed by muscles; faciae also play a role. The whole system is easily movable in different directions. Our problem is to explain how such a moving limb is at times used as an instrument for very different purposes (such as scraping, scratching, fighting etc.) and moved freely in all joints, whereas at other times it is transformed into a stiff and strong pillar, which gives the impression of being one solid column, able to carry the weight of the body ....

"We were confronted with this problem during the investigation of decerebellated animals, which had been operated upon by Dr. G. G. J. Rademaker, and of which the condition of muscle-tone had to be followed during the course of many months. It soon became evident that this was not a simple task, and that the state of tone of a limb at any given moment depended greatly upon the way in which the tone was investigated. If, for instance, the dog is lying down in the lateral position and the resistance of one forelimb against passive flexion is measured with the hand and fingers flexed, *often no resistance can be felt. But if the latter are extended and pressure* exerted against the pad of the foot, then the forelimbs become strongly extended and can hardly be flexed at all. The same difference can also be demonstrated in intact animals. We therefore decided to make a more detailed investigation of these reactions."

In referring to the results of these and other investigations Magnus (10) states, "the chief result of these investigations is that posture is an active process, and is the result of a great number of reflexes, many of which have a tonic character."

Another chance discovery made by Magnus (10) is of importance here, and is described by him as follows:

> "General static reactions in the decerebrate animal can most easily" be induced by changing the position of the head. This was discovered by chance. Many years ago I prepared a decerebrate cat with cross-section of the low thoracic cord, in order to study some reflex reactions of the tail muscles. For this purpose I brought the animal from the lateral into the supine position and noticed to my surprise a slow but very strong 'pathetic' extension of the forelimbs, which disappeared when the animal was again placed upon its side. Other changes of position evoked also tonic reactions of the forelimbs. Subsequent repetitions of the same experiment showed that various animals reacted differently. A long experimental analysis, in which I was joined by my friend, De Kleyn, was necessary until we understood the phenomenon completely. As usual the result was comparatively simple. It is possible, by giving different positions to the head, to change the distribution of tone in the whole body musculature, and (as far as decerbrate preparations are concerned) especially in the above-named group of anti-gravity muscles. The most striking reactions appear in the extensors of the limbs and in the neck muscles. The effects observed are the result of the combined reflexes from the labyrinths and from proprioceptive neck-receptors, and as the relative strength of these two influences vary from animal to animal, the different results of subsequent experiments can be understood. In this way it is possible to impress upon the whole body different adapted attitudes by changing only the position of the head......... The mechanism as a whole acts in such a way that the head leads and the body follows."

The work discussed so far has been done on embryos and experimental animals. It remains now to draw attention to experimental work on the intact human organism, the importance of which work has been realized since clinical evidence proved that neuro-muscular activity in man as well as in the higher animals is reflex in nature (12). Such investigation was carried on over a period of years by F. M. Alexander (1). In the introduction[4] to Alexander's "The Use of the Self" John Dewey writes: "Any sound plan must

> prove its soundness in reference both to concrete consequences and to general principles. What we too often forget is that these principles and facts must not be judged separately, but in connection with each other. Further, whilst any theory or principle must ultimately be judged by its consequences in operation, whilst it must be verified experimentally by observation of how it works, yet in order to justify a claim to be scientific, it must provide a method for making evident and observable what the consequences are; and this method must be such as to afford a guarantee that the observed consequences actually flow from the principle. And I unhesitatingly assert that, when judged by this standard, that is, of a principle at work in effecting definite and verifiable consequences, Mr. Alexander's teaching is scientific in the strictest sense of the word. It meets both of these requirements. In other words, the plan of Mr. Alexander satisfies the most exacting demands of scientific method."

Alexander, as did Magnus, chanced upon a combination of reflexes which effected the concerted activity of the entire body musculature. He discovered through extended experimentation that the head and neck provide the controlling influence in producing this particular reflex action, and that a certain relativity of the head to the neck and head-and-neck to the torso brings about a distribution of well directed instead of misdirected energy throughout the entire body musculature, by means of which all parts are brought into co-ordinate use. This certain relativity Alexander named the "primary control," since he found that, when actively present in any individual, it conditions all sensory-motor reactions, as well as brings into cooperation the combination of reflexes necessary to the gradual raising of the standard of use of the neuro-muscular mechanism.

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[4] Permission granted by E. P. Dutton to quote from John Dewey's introduction to F. Matthias Alexander's "Use of the Self."

As Alexander puts it: "I wish to make it plain that whenever I use the phrase 'use and functioning' in relation to the human organism, I do not indicate by it mechanical activity as such, but include in the phrase all manifestations of human activity involved in what we designate as conception or understanding, withholding or giving consent, thinking, reasoning, directing, etc. For the manifestation of such activities cannot be dissociated from the use of the mechanisms and the associated functioning of the organism." The great importance of this is the discovery of a primary control of the reflex action by means of which the use, or "manner of use," of the organism as a whole is influenced. This is not only implicit in his discussion but also in the new trend in modern science which puts emphasis upon the study of intact living organisms in differing media. A presentation of this trend can be found in L. K. Frank's paper (5). With this emphasis, it becomes necessary to have both a criterion by which the extent of integrative action characteristic of the organism under observation can be ascertained and a technique which will facilitate the functioning of the "mechanism of total integration." In dealing with the human organism, the only possible criterion is inherent in the use of the primary control of that organism: this because of the differentiation of manifestations arising from apparently similar conditions, and the dissimilarity of the changes necessary in the conditions from time to time during procedures which can lead to the eradication of these manifestations.

In experiments such as the one presented in this paper the use of the hands calls for special criticism, for it is a demonstrable fact that the human hands are one of the most powerful stimuli to habitual reaction when they touch another human being. Hence any person who attempts to help or aid an infant in such experiments as we are dealing with should be well experienced in such use of the hands, while realizing a high standard of co-ordinated use in himself through the employment of the primary control. It can be demonstrated that the results which accrue in this connection from the use of a particular person's hands will be in accordance with the standard of co-ordinated use of the whole mechanism which makes the use of the hand possible. The photographs presented here afford proof to this effect and the most casual observer cannot fail to be struck by the obvious mal-co-ordination. Thus it appears that a problem of large scientific and educational significance, when approached experimentally, yields material that points to the need for reorganizing the concepts of motor activity and the study of motor development. The implications of this for education are far-reaching.

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AGE DIFFERENCES IN BEHAVIOR AT THE NURSERY SCHOOL LEVEL[1]

LaBERTA A. HATTWICK AND MOLLIE KROM SANDERS

Laymen and technicians alike are interested in finding and understanding distinguishing characteristics for the different age levels. "What are the abilities and interests of the 2 year old? What can I expect of a 4 year old in the way of self help? In social behavior? What stages, if any, do children go through as they mature? Are certain behavior difficulties characteristic of certain age levels or stages of development?" Both in gathering of laymen, where children are being discussed, and in scientific circles, where research projects are being planned, questions such as these occupy a conspicuous position.

As evidence of the above fact, it is interesting to note that no other factor has been more consistently included in studies of children than that of age (1, p.41, p.139). Most of these studies, however, have dealt with a single, rather isolated aspect of behavior and have made the age analysis secondary to other aims. Curiously enough, attempts to make comprehensive studies of age differences per se -- especially at half year intervals as in the present report -- have not only been scarce but have usually been discouraged and disapproved. Environmental factors and individual variations in behavior have been considered too great to justify the use of such fine increments as these.

Practical demands would now seem to justify the more direct and detailed approach to the study of age differences. Today, more than ever before, children of 2, 2-1/2, 3, 3-1/2 and 4 are entering schools. Teachers are faced with the task of guiding these children so as to insure optimal development. In such a situation the teacher needs some understanding of age differences within the nursery school level. She needs to see these differences in perspective, not just as isolated facts assembled from here and there. True, the findings which research can supply may not hold for individuals, they may not even be sharply defined for groups, but even so they should provide a helpful starting point for a program which attempts to further developmental needs.

The present study, which represents one aspect of a larger project, was made to determine what behavior difficulties and personality characteristics, if any, do distinguish children at 2, 2-1/2, 3, 3-1/2 and 4 years of age. It was hoped that the study might throw some light on the developmental aspects, if any, of the so-called behavior difficulties of preschool children.[2]

SOURCE OF MATERIAL

Subjects

The main group of subjects for the present study consisted of 555 children

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[1] Grateful acknowledgements for this and for a companion article on sex differences (see Child Development, December, 1937) are hereby extended to Rose H. Alschuler whose cooperation has been most valuable in these and various other studies made by the senior author. Collection and treatment of data were made possible by the cooperation of the staffs and associated personnel of the WPA Nurseries of Chicago and the Winnetka Public School Nurseries. All of these nurseries are directed by Rose H. Alschuler.

[2] As one aspect of the present study an attempt was made to abstract and synthesize isolated age findings for behavior at the pre-school level. Wide differences in terminology, methods, age groupings, etc., made it impossible, however, to complete this work. The analysis by Jones and Burks (1) is recommended instead.

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who were distributed by age and sex as follows:

	Number of Cases		
Age	Boys	Girls	Total
2	10	13	23
2½	34	40	74
3	74	89	163
3½	98	93	191
4	52	52	104
Total			555

All of the children studied were enrolled in nursery schools. Although American children were predominent, the group also contained Negroes, Italians, Mexicans, Poles and children of mixed European extraction. A previous study (2) contains a more detailed description of the first 335 cases. A comparison of paternal occupations for this latter group with the U.S. census for 1930 revealed a marked similarity in distribution with the exception of the agricultural group which was not represented among the experimental subjects.

Length of Nursery School Attendance

It was necessary to obtain the present data in the fall of two successive years. Since many of the schools involved remained open twelve months a year --and children were not infrequently dropped and replaced at irregular intervals throughout that period-- it was impossible to secure enough cases for comparison when the age levels were equated for time in nursery school. Thus nursery school attendance is a variable factor which tends to operate in favor of the older groups. The median difference in length of nursery school attendance between any two successive age groups was found to be one month, while the greatest difference between any groups (that between the 2 and 4 year levels) was approximately five months.

Since this difference might invalidate the present findings, a check on its influence was secured before further comparisons were made. This check consisted in comparing the present, total set of data, with age data matched for nursery school attendance. Matched data were available from a previously published report (3) for 1) forty 3 and 3-1/2 year olds and sixty-two 4 and 4-1/2 year olds who had been in nursery school six weeks or less and 2) an equal number of children of the same ages who had been in nursery school seven months or more. For comparative purposes the present age data were thrown into the same age groupings as the previously published material.

The two sets of data in which age groups were equated for nursery school attendance were found to yield the same trends in behavior between successive age groups as do the data presented in this report. The actual percentages in these three sets of data were also comparable, the average difference between the present and the six weeks' data being 6 per cent and that between the present and the seven months' data 7 per cent.[3]

The different sets of data did not agree on "secretly takes property of others" (either to any or to an habitual degree) and "habitually asks unnecessary help". These traits have been omitted from the age comparisons in the present report.

The matched data revealed no age difference for "wriggles a great deal when sitting". Since they did not actually contradict the present findings, and

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[3] Other comparisons (in percentages) follow:

	6 weeks' group	7 months' group
Range of differences	0-18	0-25
50th percentile	5	6
75th percentile	8	10

since the present data are consistent for both "any" and "habitual" groupings this trait has been retained.

In general, the variable factor of nursery school attendance does not seem to have materially influenced the present results. When we stop to realize that the difference in nursery school attendance between successive age levels was only one month it seems logical that any effect or this factor would be slight.

Method

The data for the present study were obtained on a special rating scale. The general scope covered by the items includes eating, sleeping habits, elimination, nervous tendencies, speech, fears, relation to adults, relationships with other children, and general personality and emotional reactions. Specific items are indicated in Table I.

TABLE 1

FREQUENCY OF BEHAVIOR HABITS AND PERSONALITY TRAITS IN PRESCHOOL CHILDREN[1]

Behavior[2]	No. Cases[4]	Frequency Any	Frequency Marked	Behavior	No. Cases	Frequency Any	Frequency Marked
Asks unnecessary help	569	.83	.20	Twists hair	569	.49	.08
Leaves tasks incomplete	570	.83	.27	Fears high places	566	.48	.09
Wastes time at routines	569	.81	.30	Daydreams	571	.47	.15
Ignores requests	570	.76	.25	Avoids play with others	570	.46	.11
Stays awake long at nap	486	.75	.37	Chew objects	569	.44	.06
Dawdles at meals	520	.73	.33	Holds body tense	568	.43	.08
Wriggles when sitting	568	.69	.23	Rushes into danger	570	.38	.06
Looks for praise	571	.68	.16	Relates fanciful stories[3]	569	.38	.06
Criticizes others[3]	570	.66	.13	Lisps or lalls	555	.38	.16
Refuses to comply	569	.66	.17	Sucks thumb, day or night	569	.37	.10
Refuses to share	569	.64	.13	Fears strange people	564	.37	.04
Avoids risk[3]	571	.63	.16	Shrinks from notice	570	.36	.07
Resists at rest	561	.62	.27				
Seeks attention[3]	567	.62	.18	Is jealous	571	.35	.03
Cries easily	569	.62	.15	Bites nails	569	.32	.04
Picks nose	568	.62	.11	Secretly takes property[3]	570	.30	.03
Plays with fingers	569	.61	.20	Has temper outbursts	560	.29	.03
Refuses food	519	.60	.16	Breaks toys[3]	571	.28	.03
Grabs toys from children	553	.59	.15	Twitches[3]	569	.28	.04
Laughs, squeals, jumps[3]	569	.59	.22	Handles sex organs	568	.20	.04
Bosses others	570	.57	.14	Wets self during day	568	.26	.05
Gives in too easily	571	.57	.09	Fears animals	551	.24	.02
Is hard to reason with	570	.56	.15	Fears loud noises	558	.23	.02
Sulks	572	.55	.11	Misrepresents facts[3]	571	.22	.03
Remains tense at rest, nap	560	.55	.12	Stutters	557	.19	.05
Stays close to adult	570	.54	.11	Wets self during nap	503	.19	.03
Slurs or speaks indistinct	566	.51	.24	*Desires to be fed*	521	.13	.03
Stays awake during nap	487	.51	.16	Awakens crying	477	.12	.01
Attacks others	571	.50	.09	Mistreats animals	551	.11	.00
Grumbles or whines	572	.49	.10	Regurgitates food	521	.09	.01

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[1] Traits in the above table which revealed no consistant age differences and which are not discussed in the following sections are: "resists at rest", "handles sex organs", "attacks others", "mistreats animals", "sulks", daydreams", "twists hair", "chews objects". It is of interest that these are traits all of which often reflect nervous tensions or emotional insecurity.

[2] "Any" occurrence has been used as the basis for ranking behavior in the table.

[3] Complete wording of these items on the rating scale is as follows: Goes to adult, with criticism of others; avoids activities involving risk; seeks attention by calling or showing off; laughs, squeals, jumps around excessively; relates fanciful stories as real; secretly takes property of others; breaks toys, tears books, marks furniture; twitches any part of the body; misrepresents facts to gain an end.

[4] This analysis was made some what separately from that in following age tables and includes, in addition to the 555 subjects already described (p.27), twenty-four 4½ year olds.

Children were rated in terms of how frequently the given behavior had been observed during the past month; "never", "less than once a week", "once a week", "several times a week", "daily or more". Each child's score was the average of three independent judgments made by teachers who were in daily contact with the child in the school.

Reliability of Ratings. Each teacher was asked to re-rate two of her children on the sixty items, a week after the first rating was made. The agreement between first and second ratings (based on an average of 104 judgments each) ranged from 73 to 96 per cent in the case of individual teachers. The median agreement was 95 per cent.

To test the reliability of sampling, the data were also analyzed in two separate groups, one with 336 cases, the other with 237. The rank order correlations obtained from ranking the behavior items, on the basis of these two sets of data, were .89 .02 and .92 .01.

Analysis of Data

In the analysis, the percentage of children showing a given characteristic was determined for each degree of frequency. Separate age charts were secured on the basis of 1) the percentage of children showing the behavior to "any" degree and 2) the percentage of children showing the behavior to a marked or "habitual" degree (interpreted as several times a week, daily or more).

The present age groupings were so made that the reader might throw the data together into the customary twelve months' divisions, if desired. The 3 year old (two years, six months to three years, six months) would thus be represented by the 2-1/2 and 3 year old data and the 4 year old by the 3-1/2 and 4 year old data.

Only the last half of the second year is represented. Sufficient children below 24 months of age were not enrolled in the schools to make a study of children between 1;6 and 2;0 possible. This does not noticeably lessen the value of the results so far as nursery school teachers are concerned, for most schools do not take children before 24 to 30 months of age.

A very detailed study has been made of all the "peaks" and rapid declines or rises noted in a given behavior trait at successive age levels. The statistical significance of such differences has also been determined. In the summarized report presented in the following pages, the figures for the most outstanding differences are presented.

BEHAVIOR OF ALL PRESCHOOL CHILDREN

Table I contains a list of the behavior studied and of the percentage of children who exhibited each type 1) to any and 2) to a marked degree.

Comments

Approximately half of the traits studied were observed to occur to some degree in the majority (50 to 93 per cent) of the children. Even in the rather select environment of the nursery school 20 per cent or more of the children showed habitual tendencies to

Ask unnecessary help
Leave tasks incomplete
Waste time at routine
Ignore requests
Stay awake long at nap
Dawdle
Wriggle a great deal when sitting
Resist at rest
Play with fingers

Laugh, squeal, jump around excessively
Slur or speak indistinctly

Those characteristics which were found to some degree in 50 per cent or more of the children and which were habitual in 10 per cent or more of the cases fit into the picture which most of us already have of the preschool child. Preschool children are necessarily dependent upon adults--hence such over-reactions as "asks unnecessary help", "looks for praise", "goes to adult with criticism of others", "seeks attention by showing off", and "stays near adult". They still have inadequate motor control and short attention spans--hence behavior as "leaves tasks incomplete", "wastes time at routines", "dawdles". Preschool children are recognizedly very active--hence "wriggles a great deal when sitting" and "laughs, squeals, jumps around excessively". They are recognizedly negativistic--hence "ignores requests", "refuses to comply", "hard to reason with". They are also self-centered--hence "refuses to share", "grabs", "bosses", "attacks others". Similarly most of the other traits in the first half of the table reflect recognized characteristics of childhood.

The behavior found in less than 50 per cent of the children at any time and in less than 10 per cent of the children as an habitual tendency (the last half of Table I) seems, in general, to be more heavily weighted with emotional adjustments than does that previously described. All of the fears, the majority of the nervous tendencies, and such behavior as jealousy and temper outbursts, for instance, fall into this class. It may be that emotional adjustments as a whole are more representative of individual needs than of a general developmental pattern.

Obviously the interpretations given above are matters for conjecture. What is development and what is not can be settled in no such abstract manner as this. Neither can the following analysis provide the answers. But by securing a more critically descriptive picture of the various age levels than we have had before, we should obtain a better basis for seeking and understanding developmental trends as well as behavior difficulties at the preschool level.

DETAILED ANALYSIS OF AGE DIFFERENCES IN BEHAVIOR AT THE NURSERY SCHOOL LEVEL

THE TWO YEAR OLD (2:0 to 2:6)

GENERAL TENDENCIES

Children of two exhibit many tendencies which, in the normal course of events, tend to decrease gradually and regularly throughout the preschool period (Tables II and III).[4]

Comments

These tendencies at two seem to be rooted largely in a lack of control. Lack of physical control is seen in "wets self" and "breaks toys". Lack of vocomotor control is seen in "slurs" and "lisps", and possibly in such accompanying difficulties as "hard to reason with", "whines and grumbles". Lack of emotional control is suggested by "cries easily". The presence of these inabilities may also make for the two year old's lack of social interests and his hesitancy in seeking new experiences--may in other words lead to such behavior as "avoids play with others", "shrinks from notice", "fears strange people", "refuses food", "desires to be fed".

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[4] Traits typical of more than one age level are included in the table for that age at which they reach a more definite turning point (always the latter of the two levels; in this case Table III).

TABLE 2

BEHAVIOR MOST FREQUENT AT TWO
(2:0 to 2:5 inclusive)

Behavior[1]	Age Levels 2	2½	3	3½	4	Ages Compared	Critical Ratio	Chances in 100
	Percentage Showing Behavior to Any Degree							
Avoids play with others	.81	.73	.52	.39	.30	2 & 4	5.42	100
Shrinks from notice	.74	.42	.44	.28	.34	2 & 2½	2.98	100
Refuses food	.73	.60	.65	.60	.57	2 & 2½	1.15	87
Wets self, day	.61	.57	.31	.17	.11	2 & 4	4.67	100
Sucks thumb	.46	.44	.41	.36	.34	2 & 4	1.01	84
Desires to be fed	.32	.28	.18	.10	.02	2 & 4	2.90	100
Cries easily[2]	.83	.74	.62	.67	.49	2 & 4	3.70	100
Lisps[2]	.59	.45	.40	.34	.37	2 & 3½	2.25	99
	Percentage Showing Behavior to Marked Degree							
Avoids play with others	.26	.17	.15	.10	.06	2 & 4	2.10	98
Shrinks from notice	.17	.11	.07	.06	.07	2 & 3	1.38	92
Refuses food	.33	.22	.18	.15	.12	2 & 4	1.94	97
Wets self	.26	.11	.06	.01	.04	2 & 3½	2.69	100
Sucks thumb	.18	.14	.12	.09	.08	2 & 4	1.14	87
Desires to be fed	.09	.04	.04	.02	.01	2 & 4	1.27	89
Dawdles at meals[3]	.55	.40	.33	.36	.31	2 & 4	2.11	98
Plays with fingers[3]	.30	.28	.23	.19	.17	2 & 4	1.25	89
Picks nose[3]	.30	.17	.16	.11	.11	2 & 4	1.88	97
Breaks toys[3]	.14	.03	.01	.02	.02	2 & 2½	1.49	93
Fears loud noises[3]	.10	.02	.02	.02	.02	2 & 2½	1.25	89

[1] Traits in this and the following tables have been ranked so that those which are high in both any and marked groupings precede those which appear in only one grouping and (2) so that the higher frequencies, within the above limits, are given first place.

[2] As habitual occurrences, these traits are most frequent at 2½ years.

[3] As general occurrences, "dawdles", is unrelated to age; "nose-picking" and "play with fingers" tend to increase with age but present too irregular a pattern to be included among any age tables; "breaks toys" and "fears loud noises", are as frequent or more frequent at 2½ as at 2.

It is not improbable that some of this behavior at two - as "cries easily", "sucks thumb", "desires to be fed" - is more truly an infantile than a two year old pattern, and that it has persisted largely because of common environmental weaknesses. Both "desires to be fed" and "cries easily", for example, would no doubt disappear earlier if the child were expected to feed himself when able and if he didn't get what he wanted by crying.

HABITUAL REACTIONS (BEHAVIOR PROBLEMS)

In practice the types of behavior just discussed are considered a problem only when they occur very frequently or habitually. The present section is based upon such habitual occurrences.

Comments

On the whole the behavior most generally found in the 2 year old is also a more frequent problem at this level.[5] In other words, the discussion given above for behavior tendencies also holds for behavior difficulties. The additional behavior difficulties found in Table II for the 2 year old only serve to exemplify further the preceding points.

Lack of physical control would seem, for instance, to be at least a partial factor in the so-called dawdling of the 2 year old. Lack of social interests

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[5] The two exceptions to this are "cries easily" and "lisps" which, while frequent at 2, are slightly more so at 2½.

TABLE 3

BEHAVIOR WHICH REACHES A PEAK OR TURNING POINT AT 3½
(2:6 to 2:11 inclusive)

Behavior[1]	Age Level 2	2½	3	3½	4	Ages Compared	Critical Ratio	Chances in 100
				Percentage Showing Behavior to any Degree				
Ignores requests	.74	.84	.75	.74	.74	2½ & 3	1.55	93
						2½ & 2	0.95	83
Avoids activities involving risk	.56	.73	.67	.60	.58	2½ & 2	1.47	93
						2½ & 4	2.11	98
Grabs toys	.65	.72	.60	.52	.63	2½ & 3½	3.08	100
Refuses to share	.54	.72	.64	.61	.70	2½ & 2	1.49	93
						2½ & 3½	1.65	94
Refuses to comply	.61	.72	.69	.66	.64	2½ & 2	0.91	82
						2½ & 4	1.06	85
Hard to reason with	.65	.68	.54	.54	.52	2½ & 3	2.06	98
Slurs	.68	.67	.54	.45	.44	2½ & 3½	3.32	100
Stays close to adult	.43	.66	.55	.49	.51	2½ & 2	1.97	98
						2½ & 3½	2.66	100
Grumbles or whines	.61	.60	.50	.45	.51	2½ & 3½	2.16	98
Gives in too easily	.52	.60	.43	.57	.57	2½ & 2	0.67	74
						2½ & 3	2.46	99
Asks unnecessary help[2]	.65	.82	.74	.71	.68	2½ & 2	1.55	93
						2½ & 4	2.19	99
Fears high places[2]	.45	.59	.57	.45	.35	2½ & 2	1.16	87
						2½ & 4	3.24	100
Breaks toys[2]	.41	.42	.33	.23	.23	2½ & 3½	2.92	100
Fears loud noises[2]	.19	.28	.27	.23	.15	2½ & 2	0.89	82
						2½ & 4	2.06	98
				Percentage Showing Behavior to Marked Degree				
Ignores requests	.22	.32	.25	.24	.18	2½ & 2	0.98	84
						2½ & 4	2.06	98
Avoids activities involving risk	.14	.29	.19	.14	.09	2½ & 2	1.67	96
						2½ & 4	3.34	100
Grabs toys	.13	.29	.15	.12	.12-	2½ & 2	1.76	96
						2½ & 3½	2.70	100
Refuses to share	.17	.19	.15	.11-	.09	2½ & 4	1.85	97
Refuses to comply	.13	.23	.16	.18	.17	2½ & 2	1.18	88
						2½ & 4	0.99	84
Hard to reason with	.22	.20	.13	.15	.14	2½ & 3	1.30	90
Slurs	.12	.40	.25	.19	.19	2½ & 2	3.11	100
						2½ & 3½	3.30	100
Stays close to adult	.04	.21	.08-	.10	.05	2½ & 2	2.70	100
						2½ & 4	3.08	100
Grumbles or whines	.09	.17-	.11	.08	.10	2½ & 2	1.01	84
						2½ & 3½	1.91	97
Gives in too easily	.00	.12	.09	.10	.06	2½ & 2	3.18	100
						2½ & 4	1.33	91
Wastes time at routines[3]	.09	.42	.38	.25	.23	2½ & 2	3.99	100
						2½ & 4	2.64	99
Cries easily[3]	.17	.22	.18	.13	.12	2½ & 2	0.54	71
						2½ & 4	1.73	96
Lisps[3]	.18	.22	.15	.17	.14	2½ & 2	0.37	64
						2½ & 4	1.35	91
Rushes into danger[3]	.04	.10	.05	.03	.07	2½ & 2	1.09	86
						2½ & 3½	1.89	97

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[1] For order of traits see footnote 1, Table II.

[2] For habitual occurrence "asks help" was not included in the report (p.28)—"fears high places", "breaks toys", "fears loud noise", were most frequent at 3 and 2 respectively.

[3] For any occurrence "cries easily" and "lisps" were most frequent at 2 and "wastes time" and "rushes into danger" were unrelated to age.

would seem to underly "refuses to share" - (in Table III since it is equally outstanding at 2 and 2-1/2). "Picks nose" may also be a partial index of non-social interests since it is a socially unaccepted trait and would conceivably tend to decrease as the child becomes more interested in other people and in their opinions.

Such behavior as "picks nose" and "plays with fingers" may be in part an infantile carry-over of interest in self-manipulation. Fear of loud noises is a recognized tendency in infants and would seem to be another infantile carry-over. It, interestingly enough, disappears almost completely between the ages of 2 and 2-1/2.

Further Comments and Interpretations

If we had been able to secure subjects of a younger age we would undoubtedly have found that some of the behavior discussed above really reaches its peak in infancy, and that the 2 year level marks but one step in the gradual decrease of the behavior. Crying, wetting and the types of self-manipulation already noted seem to be examples at point.

Other forms of behavior discussed seem to be more specifically descriptive of the 2 year old's life. The 2 year old's inadequate motor and vocomotor control and his undeveloped social interests seem quite naturally to make for 1) occasional lapses in physical control, 2) speech inaccuracies and difficulties, 3) a paucity of social activities and interests, and 4) a general hesitancy in adventuring or accepting new experiences.

THE TWO AND A HALF YEAR OLD (2:6 to 3:0)

GENERAL TENDENCIES

Behavior most often observed at 2-1/2 is listed in Table III.

Comments

It is apparent that much of the behavior singled out for discussion at the 2-1/2 year level is present in a large percentage if not the majority of children at other ages. In other words a first hand observer would probably be unable to see age differences in these traits. The critical ratios, however, indicate that these types of behavior are more pronounced at 2-1/2 than at other age levels studied and hence suggest that they may have special significance at this period.

What at first may appear to be an heterogeneous assortment of traits--as "refusing to comply with adult requests", "ignoring requests", "asking unnecessary help", "grabbing toys", "giving in too easily", "refusing to share", becomes understandable if we realize that the child at 2-1/2 is In the early stages of active experimentation both with materials and with other individuals. He probably asks help, just as he refuses to cooperate, because he does not yet have the proper perspective on his own abilities or inabilities. He gives in, just as he grabs or refuses to share, because he does not know as yet what are the best ways of making social contacts. He avoids risk just as he rushes into danger[6] because he has had insufficient experience in the past to be able to judge what is and what is not harmful.

The negativism which has long been an accepted but somewhat isolated characteristic of the 2-1/2 and 3 year old would seem from the above facts to be but one aspect of this general experimentation. "Refuses to comply", "ignores requests", "refuses to share", are no more significant than "asking unnecessary help", or than some of the other types of more submissive behavior.

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[6] See section on "habitual" behavior. There were no age differences in the proportion of children showing any tendencies to rush into danger.

In addition to the above traits the 2-1/2 year old still displays many of the characteristics common to the 2 year old. He frequently "breaks toys", an indication that he still lacks adequate motor control and an adequate understanding of the care of materials. He still "slurs", "is hard to reason with" and "whines and grumbles". He also displays a tendency toward temper outbursts (Table IV). These facts suggest that the 2-1/2 year old still lacks accurate vocomotor control and that he has not yet learned to replace the emotional behavior of the infant with his newly developed ability to talk and hence to reason. Apparently development along these lines is not so great as to bring about obvious differences in 2 and 2-1/2 year olds.

HABITUAL BEHAVIOR

Comments

The various examples of active experimentation noted above are equally conspicuous in the list of behavior problems typical at 2-1/2. "Avoids risk" and "rushes into danger" occur side by side. So do "refuses to share", "grabs toys", and "gives in too easily". Other examples include "refuses to comply", "ignores requests" and "stays close to adults".

The difficulties associated with learning to talk are also conspicuous in the problems of the 2-1/2 as well as the 2 year old. At the risk of undue repetition it seems justifiable to raise the question as to whether adults adequately realize what a difficult adjustment language acquisition involves or how many phases of behavior it may effect.

Wasting of time at routines is a conspicuous problem at 2-1/2 (and also at 3). It was, in fact, the one problem about which teachers seemed most aware. It is natural that routine habits would be conspicuous at this level, for it is here that children are first expected to, and are most actively trying to help themselves. It is also probable, however, that we use a fallacious standard in judging this behavior. If we judge in terms of time, as most of us tend to do, we must remember that the child naturally takes longer to do a task alone than with assistance, such as he had at an earlier age.

Further Comments and Interpretation

The present section gives us a setting for the previously isolated but accepted fact that negativism is greatest in children between 2-1/2 and 3. The section has indicated that a number of contrasting forms of behavior--giving in too easily as well as refusing to comply or share, avoiding risk as well as rushing into danger - are prevalent at this age while the child is seeking, through active experimentation, to know what are the best ways of handling the situations that he must meet. Negativism is only one of these exploratory types of behavior. It has been in the limelight so much in the past that it has no doubt tended to obscure these other equally significant reactions.

The very multiplicity of reactions which the term negativism has been used to imply has also no doubt made for confusion. In most studies the term negativism has included all forms of behavior other than complying with the stated task. Thus crying, clinging to mother, or hanging one's head were considered as negativistic as a defiant "no"! or as hitting, kicking or throwing away the involved materials. It seems to the writer that much of the work on negativism has hampered more than furthered our understanding of child development through this failure to classify and treat separately withdrawing and aggressive type of reaction. The present data together with a forthcoming report on sex differences seem to give some justification for that belief.

THE THREE AND THREE AND A HALF YEAR OLD (3:0 to 3:11)

GENERAL TENDENCIES AND HABITUAL BEHAVIOR

It is well recognized that increments of growth or change become less with increasing age. *Day by day studies are necessary to catch important changes* in the newborn infant whereas monthly or yearly studies suffice in the case of the older individual. Perhaps this same principle is operating in the present set of data. At least, it seems more meaningful to consider the 3 and 3-1/2 year olds as a single group than to seek distinguishing characteristics between them.

From Table IV it is evident that there is a scarcity of behavior difficulties typical of children between 3 and 4. Changes in behavior are as significant during this period as are distinctive peaks. "Wriggles a great deal when sitting" and "Fears strange people", for instance, show their most marked change, a decrease, between 3 and 3-1/2. An examination of other tables in the present report also indicates that the period between 3 and 4 is an in-between stage during which behavior which was characteristic at 2 is continuing to decline or in which behavior which will be prominent at 4 is beginning to increase.

TABLE 4

BEHAVIOR REACHING TO PEAKS AND TURNING POINTS AT 3 AND 3½ YEARS OF AGE
(3:0 to 3:11 inclusive)

Behavior	Age Levels Studied 2	2½	3	3½	4	Ages Com-pared	Critical Ratio	Chances in 100
Percentage Showing Behavior to Any Degree								
Most rapid change between 3 & 3½								
Wriggles when sitting	.70	.74	.73	.62	.67	3 & 3½	2.20	99
Fears strange people	.80	.47	.48	.36	.20	3 & 3½	1.15	87
						3 & 4	1.88	97
Peaks at 3 or 3½								
Fears animals[1]	.22	.39	.42	.26	.29	3 & 2	2.04	98
Jealous	.21	.31	.28	.38	.35	3 & 3½	2.04	98
						3½ & 2	1.79	96
Has temper outbursts	.35	.43	.34	.45	.22	3 & 3½	2.21	99
						3½ & 4	4.20	100
Percentage Showing Behavior to Marked Degree								
Most rapid change between 3 & 3½								
Wriggles when sitting	.26	.28	.32	.21	.17	3 & 3½	2.34	99
Fears strange people	.05	.07	.10	.04	.03	3 & 3½	2.31	99
Fears high places[2]	.14	.15	.14	.07	.01	3 & 4	4.33	100
						3 & 3½	2.59	99
Peaks at 3 or 3½								
Laughs, Squeals, Jumps[2]	.13	.14	.26	.27	.22	3 & 2	1.68	96
						3½ & 4	0.96	83

[1] As habitual occurrences these traits were unrelated to age.

[2] As a general occurrence, "fears high places" is greatest at 2½ years, laughs, squeals, jumps is unrelated to age.

Comments and Interpretations

The above facts suggest that the period between 3 and 4 years of age may be one in which the child is becoming integrated. He has explored many contrasting forms of behavior in the preceding year. Perhaps now he is selecting certain of these modes of behavior to be built into a characteristic pattern of response.

There are other reasons than those already given to suggest that the above supposition is worth considering. For one, it should be remembered that the child at 3 and 3-1/2 is relatively free from variety of new adjustments--such as learning to walk, learning to talk, learning to recognize and accept the necessary aspects of one's daily routine--which he is acquiring at a younger age. In one sense the 3 year old seems to have reached a level where he can pause for a "breathing spell". He is still actively learning in the sense that he is broadening and evaluating his experiences and that he is practising and improving his own ability and skills, but he is acquiring little knowledge or ability which is distinctive from the earlier or succeeding year. The specific types of behavior listed in Table IV also lend support to the suggestion that the child at 3 and 3-1/2 years of age may be going through a period of integration and of re-evaluation.

THE FOUR YEAR OLD (4:0 to 4:6)

GENERAL TENDENCIES AND HABITUAL BEHAVIOR

At 4 years of age a group of traits which has not been previously discussed stands out in sharp relief (Table V). Most of these traits have shown a regular and significant increase in occurrence between 2 and 4. While some of them--as "relates fanciful stories as real", "misrepresent facts"--were not observed in any 2 year old, all but three are found in the majority of 4 year old children.

Comments

Such tendencies as "looks for praise", "seeks attention by showing off", and "criticizes others", suggest that the child at 4 is aware not only of other people but also of other peoples' attitudes and opinions. Social influences have become increasingly important factors between 2 and 4.

The prevalence of "relates fanciful stories" and "misrepresents facts" also suggests that ideation has become an important factor in the 4 year old. Between 2 and 4 also the child has gained sufficient mastery of language so that the process of using words does not absorb his time. He is now experimenting with words and ideas just as he experimented with materials at an earlier level. Only as he experiments with ideas does the problem of distinguishing between the real and the unreal become apparent. During the time that the child is learning this distinction it is natural that many fanciful stories should result. If by chance these fanciful stories are believed and bring desirable results the child is likely to try purposely misrepresenting facts to gain an end.

It seems unnecessary, at this point, to discuss in any detail the other types of behavior most frequent in 4 year olds. These findings are presented in Table V. Most of them are supported by other investigations. The peaks in such nervous tendencies as "twitches", "bites nails", "holds body tense", for instance are in keeping with the findings of Olson[7] that nervous tendencies tend to increase during the preschool years. The peak in "bosses others" at 4, as well as the secondary peaks in "grabs toys" and "refuses to share" (see Table III) are in keeping with the growth of selfishness which Berne[8] found to increase with age.

In closing the above section it should again be noted that the discussion of certain types of behavior in any one age group in no way excludes them from other levels. Such behavior as "refuses food", "asks unnecessary help", "ignores requests", "avoids risk", "refuses to comply", "stays near adults", etc., while all more prevalent at an earlier level, are still very common at 4 years of age. In other words, the distinctions drawn between age levels represent differences in emphasis rather than differences in types of behavior found. They are of value only as they tend to give perspective to our work.

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[7] Olson, Willard C: The Measurement of Nervous Habits in Normal Children: Minneapolis, Minn., Univ. Minnesota Press, (1929) pp. XII, 97.

[8] Berne, Esther Van Cleave: An Experimental Investigation of Social Behavior Patterns in Young Children: Univ. Iowa Stud., Stud. In Child Welfare, 1930, 4, No. 3, pp. 93 (p. 88).

TABLE 5

BEHAVIOR MOST FREQUENT AT FOUR
(4:0 to 4:5 inclusive)

Behavior[1]	Age Level					Ages Compared	Critical Ratio	Chances in 100
	2	2½	3	3½	4			
Percentage Showing Behavior to Any Degree								
Criticizes others	.43	.58	.61	.71	.86	4 & 2	3.91	100
Awake long at nap	.57	.69	.72	.70	.85	4 & 2	2.40	99
Looks for praise	.43	.61	.68	.69	.80	4 & 2	3.32	100
Bosses others	.26	.41	.54	.61	.72	4 & 2	4.50	100
Seeks attention	.32	.53	.57	.68	.72	4 & 2	3.64	100
Awake during nap	.33	.35	.42	.50	.81	4 & 3½	5.60	100
Relates fanciful stories	.00	.23	.39	.39	.50	4 & 2	10.20	100
Misrepresents facts	.00	.16	.22	.25	.27	4 & 2	6.30	100
Twitches	.26	.24	.28	.26	.37	4 & 2	1.07	85
Stutters[2]	.18	.12	.18	.20	.25	4 & 2½	2.24	99
Bites Nails[2]	.21	.27	.27	.33	.41	4 & 2	2.00	98
Holds body tense[2]	.30	.35	.45	.44	.50	4 & 2	1.85	96
Percentage Showing Behavior to Marked Degree								
Criticizes others	.04	.06	.08	.16	.18	4 & 2	2.50	99
Awake long at nap	.24	.19	.31	.40	.49	4 & 2½	4.24	100
Looks for praise	.04	.14	.16	.21	.30	4 & 2	4.25	100
Bosses others	.00	.03	.09	.18	.27	4 & 2	6.20	100
Seeks Attention	.04	.12	.15	.21	.21	4 & 2	2.97	100
Awake during nap	.14	.09	.14	.15	.20	4 & 2½	2.00	98
Relates fanciful stories	.00	.02	.04	.06	.10	4 & 2	3.39	100
Misrepresents facts	.00	.02	.01	.03	.03	4 & 2	1.80	96
Twitches	.00	.04	.05	.02	.08	4 & 2	3.02	100

[1] For order see footnote 1, Table II.

[2] As habitual occurrences these traits are unrelated to age.

CONCLUSION

As ideas which we should at least consider in developing a perspective on preschool children the preceding data:

1. Have pointed up the lack of control and the consequent infantile, self-centered characteristics of the 2 year old.
2. Have indicated that a great deal of experimentation is occurring at the 2-1/2 year old level, and have suggested the place which negativism should hold in this entire scheme.
3. Have thrown the 3 and 3-1/2 year levels into relief as a period in which few distinctly new abilities or experiences are occurring but in which a process of integration and re-evaluation is quite possibly going on.
4. Have given emphasis to the strong rule which ideas and opinions are beginning to play in the life of the 4 year old.

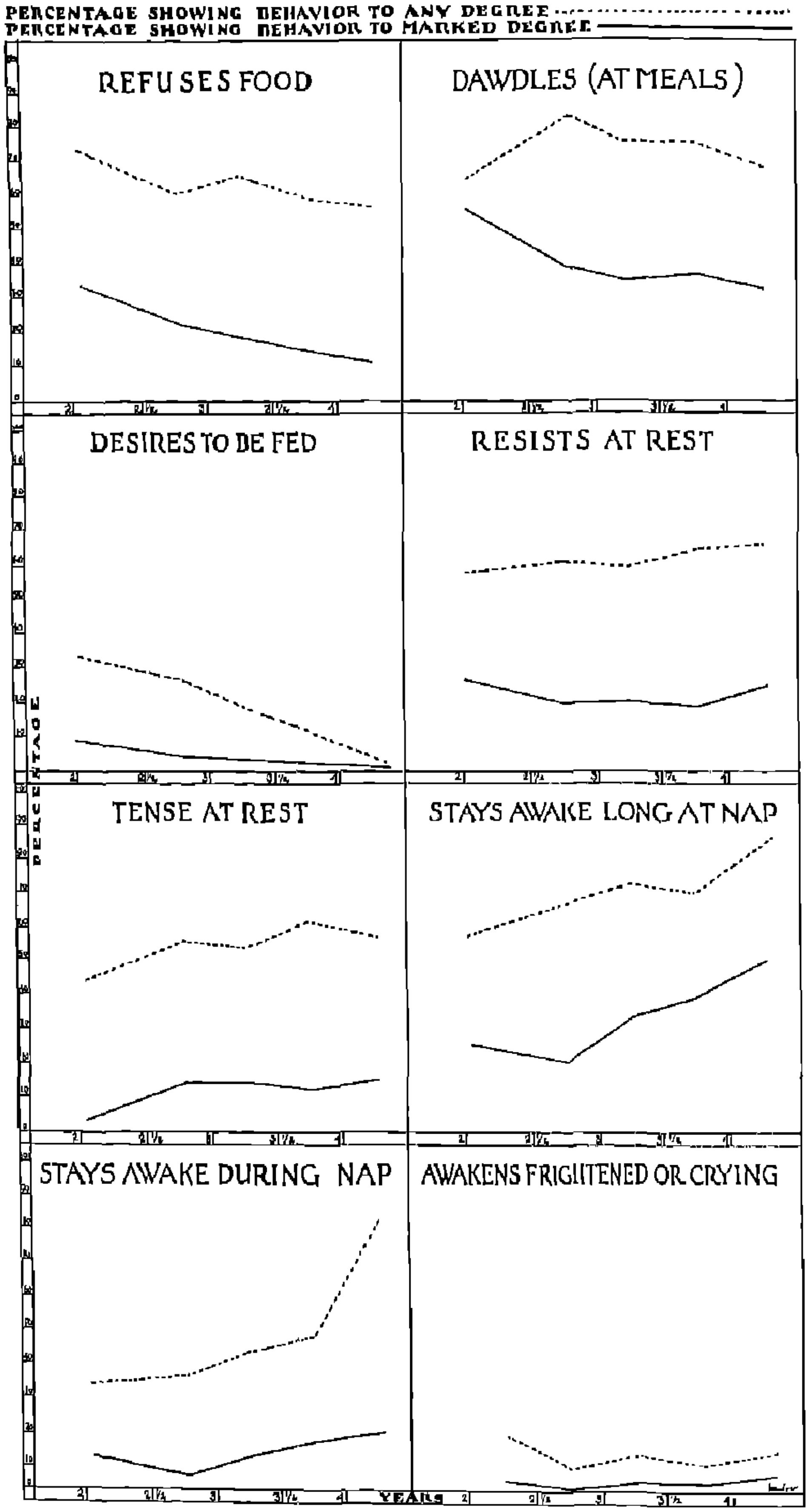
TABLE 6

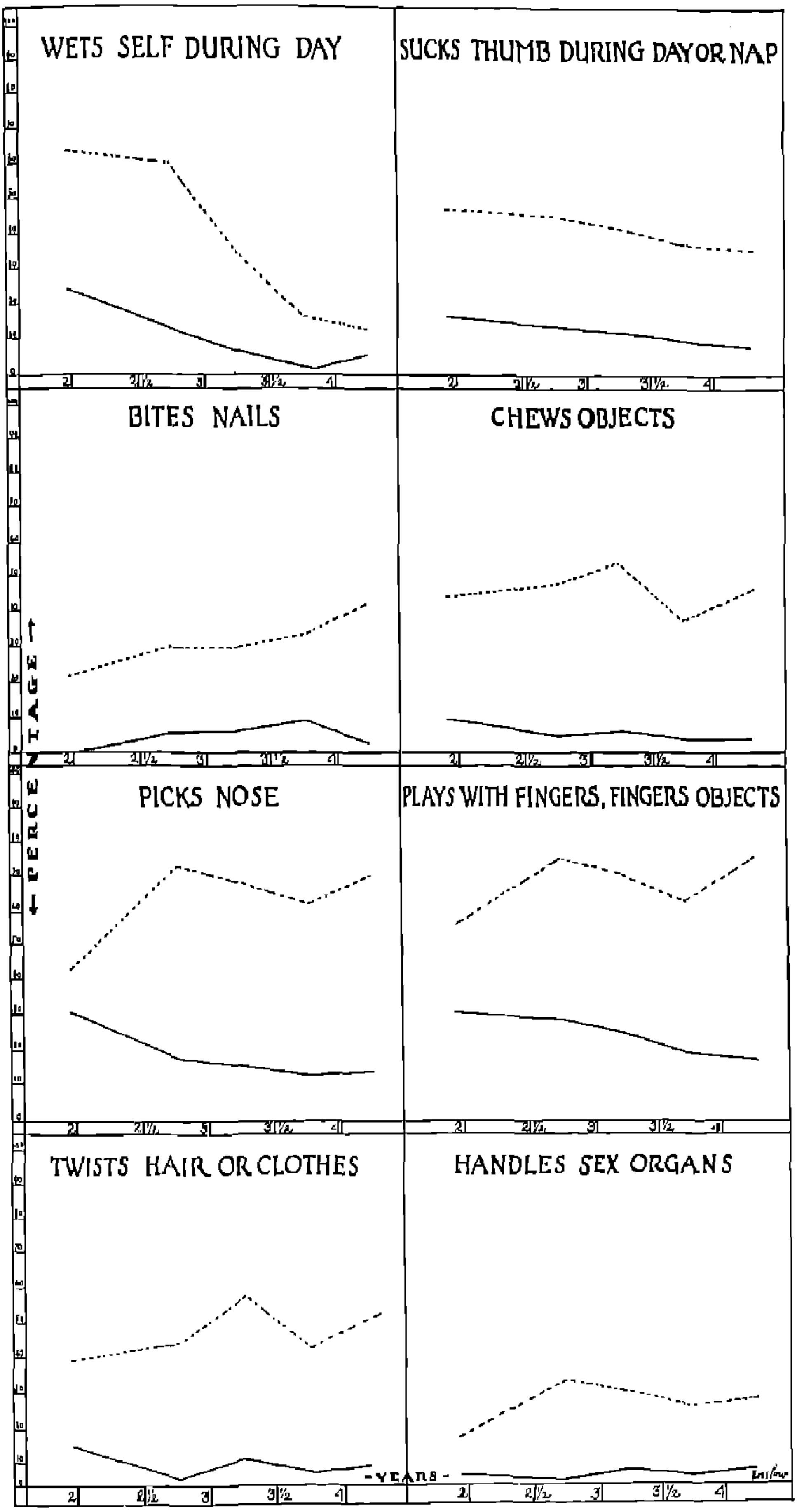
BASIC DATA: NUMBER OF CASES AND
PERCENTAGE OF CASES SHOWING DEGREE OF BEHAVIOR

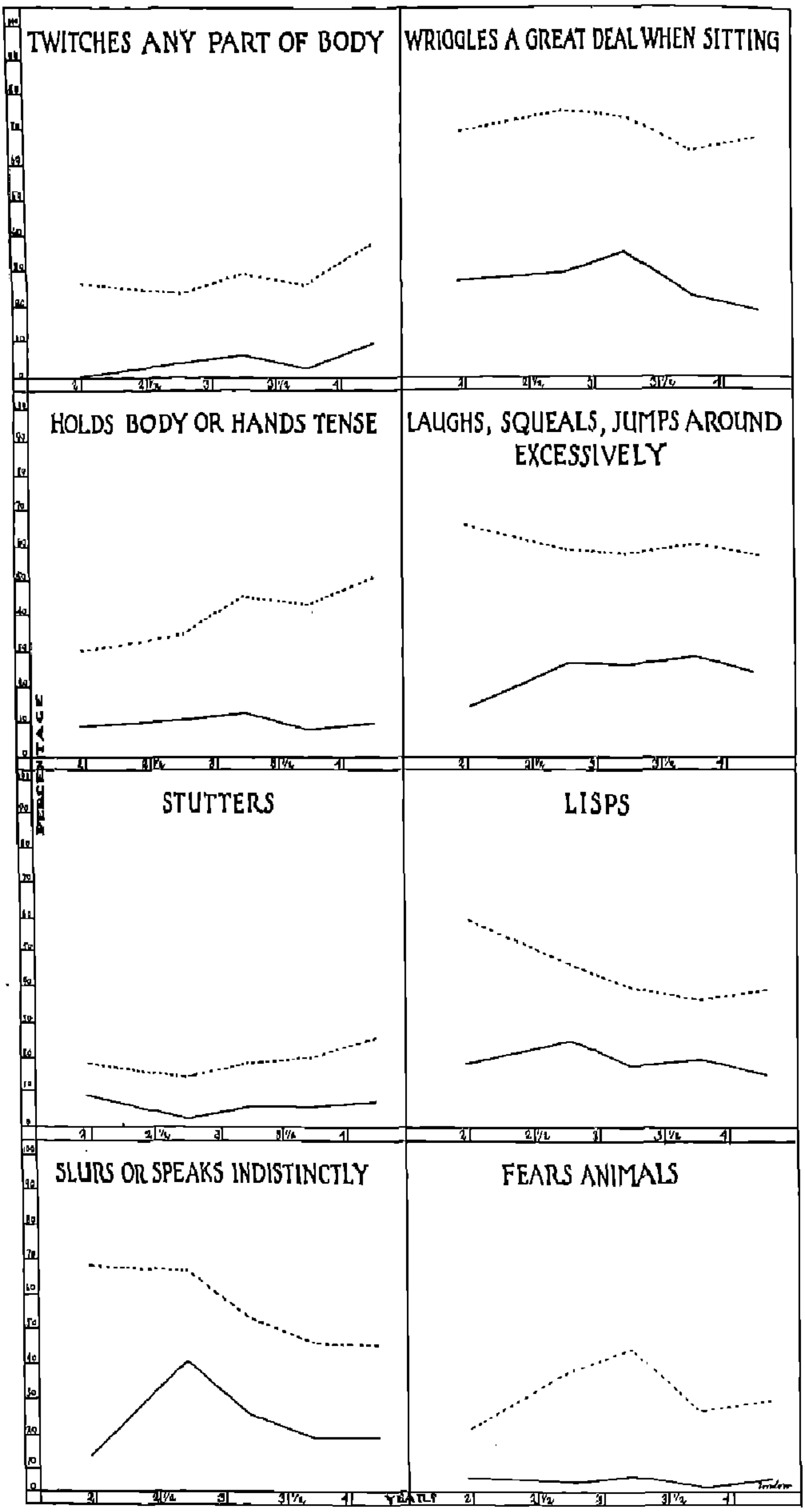
Ages:
2 yrs = 2:0-2:5
2½ yrs = 2:6-2:11
3 yrs = 3:0-3:5
3½ yrs = 3:6-3:11
4 yrs = 4:0-4:5

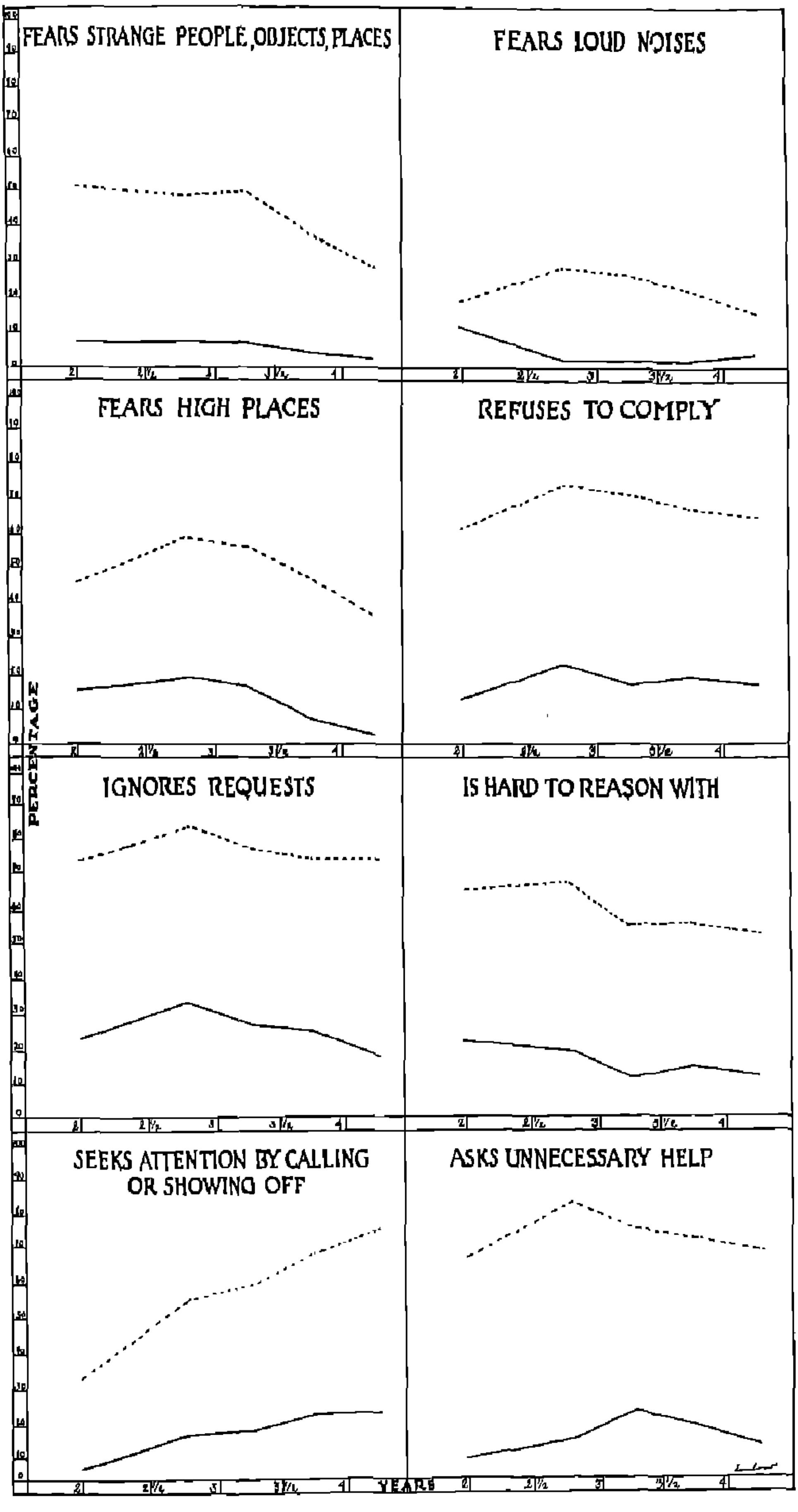
	Percentage of Cases										Number of Cases					
	To any degree					To marked degree										
	Age (years)					Age (years)					Age (years)					All
	2	2½	3	3½	4	2	2½	3	3½	4	2	2½	3	3½	4	Ages
Refuses food	73	60	65	60	57	33	22	10	16	12	21	71	147	175	92	506
Dawdles (at meals)	64	82	76	74	69	56	40	33	36	31	21	71	147	174	92	505
Desires to be fed	32	20	10	10	2	9	4	4	2	1	21	71	147	176	92	506
Resists at rest	67	62	60	64	66	26	21	21	20	26	23	74	162	180	101	548
Tense at rest	43	53	63	60	67	4	14	14	11	13	23	73	162	187	102	547
Stays awake long at nap	57	69	72	70	65	24	19	31	40	49	21	68	147	167	90	493
Stays awake during nap	33	25	42	50	61	14	9	14	16	20	21	68	146	168	90	493
Awakens frightened or crying	19	9	13	10	13	2	0	1	1	1	21	68	143	162	89	483
Wets self during day	61	57	31	17	11	26	11	6	1	4	23	74	162	109	104	552
Sucks thumb during day or nap	46	44	41	36	34	18	14	12	9	8	21	73	161	191	103	549
Bites nails	21	27	27	33	41	0	4	4	5	2	23	74	162	190	104	553
Chews objects	43	47	52	36	44	9	0	0	5	5	23	74	161	191	104	555
Picks nose	43	72	68	62	70	30	17	16	11	11	23	74	160	191	104	552
Plays with fingers, fingers objects	56	73	70	62	73	30	20	23	19	17	23	74	162	190	104	553
Twists hair or clothes	39	43	50	43	51	13	5	11	6	8	23	74	162	190	104	553
Handles sex organs	17	31	30	25	28	4	3	5	4	4	23	74	160	191	104	552
Twitches any part of body	26	24	28	26	37	0	4	5	2	0	23	74	161	191	104	553
Wriggles a great deal when sitting	70	74	73	62	67	26	20	32	21	17	23	74	161	190	104	552
Holds body or hands tense	30	35	45	44	50	9	10	11	6	9	23	74	162	191	104	554
Laughs, squeals, jumps around excessively	64	60	59	60	67	13	14	26	27	22	23	74	162	191	104	554
Stutters	18	12	16	20	25	9	1	5	5	6	22	73	152	109	104	540
Lisps	59	45	40	34	37	10	22	16	17	14	22	74	159	109	104	540
Slurs or speaks indistinctly	68	67	54	45	44	12	40	25	19	19	22	74	161	190	103	550
Fears animals	22	39	42	26	29	6	3	4	2	3	22	69	155	107	103	536
Fears strange people, objects and places	50	47	40	36	28	5	7	10	4	3	22	73	160	190	103	548
Fears loud noises	19	28	27	23	16	10	2	2	2	2	21	72	157	190	102	542
Fears high places	45	59	57	45	35	14	16	14	7	1	22	74	160	190	103	549
Refuses to comply	61	72	69	66	64	13	23	16	18	17	23	74	162	190	104	553
Ignores requests	74	84	75	74	74	22	32	26	24	18	23	74	162	169	104	552
Is hard to reason with	65	68	54	54	52	22	20	13	15	14	23	74	163	190	104	554
Seeks attention by calling or showing off	32	53	67	68	72	4	12	16	21	21	22	74	160	190	104	550
Asks unnecessary help	65	82	74	71	68	9	14	23	20	12	23	73	163	190	104	553
Looks for praise	43	61	68	69	80	4	14	16	21	30	23	74	163	191	104	555
Goes to adult with criticism of others	43	50	61	71	66	4	6	8	16	16	23	74	163	190	104	554
Stays close to adult	43	66	55	49	51	4	21	0	10	5	23	74	163	190	104	554
Shrinks from notice	74	42	44	28	34	17	11	7	6	7	23	74	163	190	104	554
Avoids play with others	61	73	52	39	30	26	17	15	10	6	23	73	163	191	104	554
Bosses others	26	41	54	61	72	0	3	9	18	27	23	73	163	190	104	553
Gives in too easily	52	60	43	57	67	0	12	9	10	6	23	74	163	191	104	555
Refuses to share or take turns	54	72	64	61	70	17	19	15	11	9	23	74	161	191	104	553
Grabs toys from other children	65	72	60	52	63	13	29	15	12	12	23	74	162	174	104	537
Attacks others (hits, kicks, bites, scratches, etc.)	61	54	46	55	55	22	11	9	11	14	23	74	163	191	104	555
Is jealous of others	21	31	28	38	35	4	2	4	3	3	23	74	163	191	104	555
Sulks ('is moodily silent, resists advances')	61	54	59	62	56	17	14	9	10	16	23	74	162	191	104	554
Grumbles or whines	61	60	50	46	51	9	17	11	8	10	23	74	162	191	104	554
Cries easily	63	74	62	67	49	17	22	16	13	12	23	74	162	190	104	553
Has temper outbursts (screams, kicks, strikes, throws self on floor)	35	43	34	45	22	9	3	3	2	5	23	74	152	191	104	544
Breaks toys, tears books, marks furniture	41	42	33	23	23	14	3	1	2	2	22	74	163	191	104	554
Mistreats animals	14	9	14	11	7	0	0	1	0	0	21	70	166	107	100	543
Wastes time at routine tasks	67	61	62	78	62	9	42	30	26	23	23	74	162	190	104	553
Leaves task incomplete	83	91	83	80	80	17	42	36	18	17	23	74	163	190	104	554
Daydreams	48	66	71	69	63	14	18	15	15	11	23	74	163	191	104	555
Relates fanciful stories as real	0	23	39	39	50	0	2	4	6	10	23	74	162	190	104	553
Misrepresents facts (purposely, to gain an end)	0	16	22	25	27	0	2	1	3	3	23	74	163	191	104	555
Secretly takes property of others	13	28	33	27	25	4	3	4	2	1	23	74	153	191	104	544
Rushes into danger	41	40	37	36	39	4	10	5	3	7	22	74	163	191	104	555
Avoids activities involving physical risk	56	73	67	60	50	14	29	19	14	9	23	74	163	191	104	555

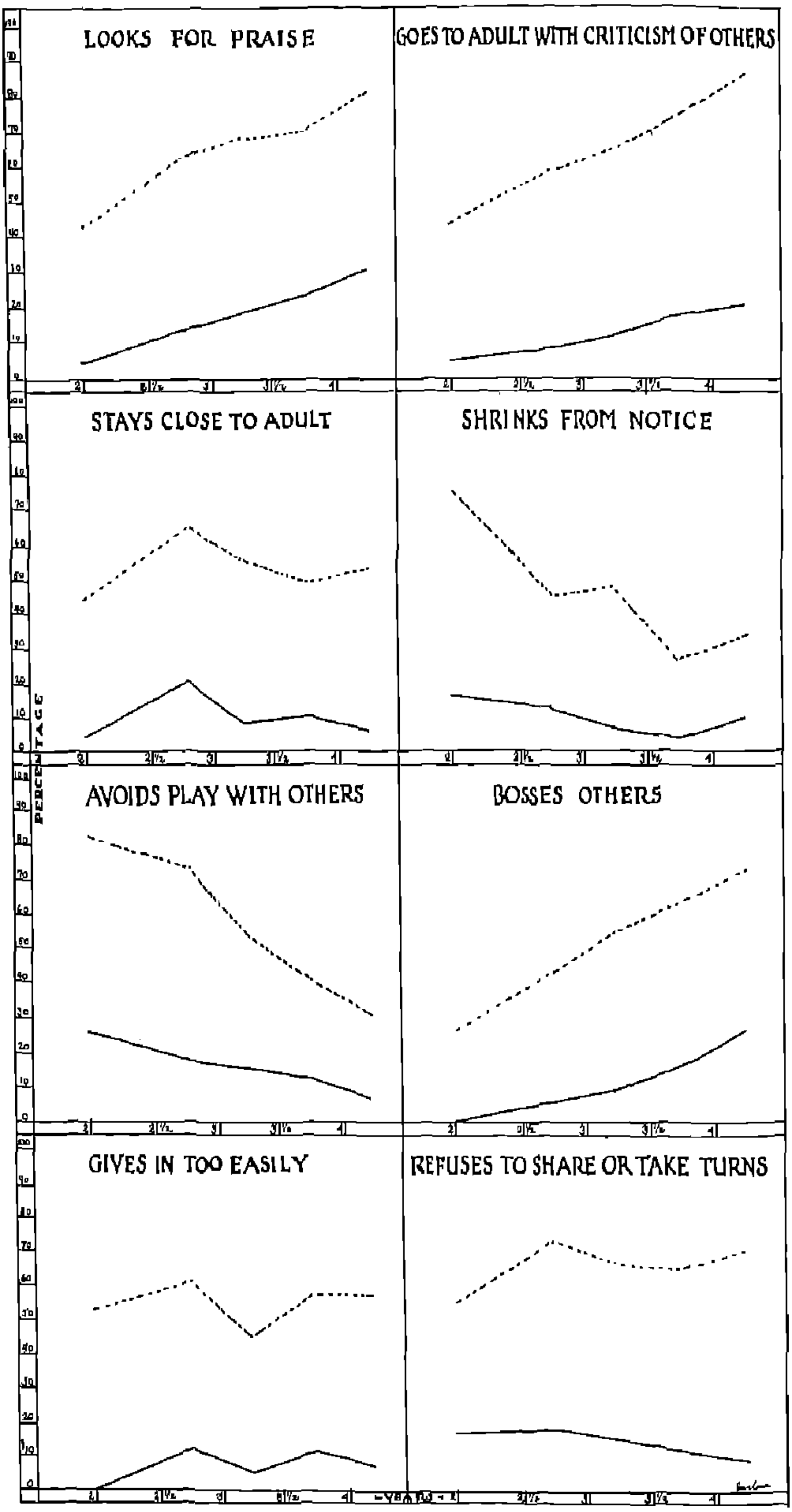
AGE DIFFERENCES IN BEHAVIOR AT THE NURSERY SCHOOL LEVEL




WETS SELF DURING DAY
SUCKS THUMB DURING DAY OR NAP
BITES NAILS
CHEWS OBJECTS
PICKS NOSE
PLAYS WITH FINGERS, FINGERS OBJECTS
TWISTS HAIR OR CLOTHES
HANDLES SEX ORGANS
← PERCENTAGE →
- YEARS -
2
2½
3
3½
4


TWITCHES ANY PART OF BODY
WRIGGLES A GREAT DEAL WHEN SITTING
HOLDS BODY OR HANDS TENSE
LAUGHS, SQUEALS, JUMPS AROUND EXCESSIVELY
STUTTERS
LISPS
SLURS OR SPEAKS INDISTINCTLY
FEARS ANIMALS
PERCENTAGE
YEARS
0
10
20
30
40
50
60
70
80
90
100
2
2½
3
3½
4


FEARS STRANGE PEOPLE, OBJECTS, PLACES
FEARS LOUD NOISES
FEARS HIGH PLACES
REFUSES TO COMPLY
IGNORES REQUESTS
IS HARD TO REASON WITH
SEEKS ATTENTION BY CALLING OR SHOWING OFF
ASKS UNNECESSARY HELP
PERCENTAGE
YEARS
2
2½
3
3½
4



LOOKS FOR PRAISE

GOES TO ADULT WITH CRITICISM OF OTHERS

STAYS CLOSE TO ADULT

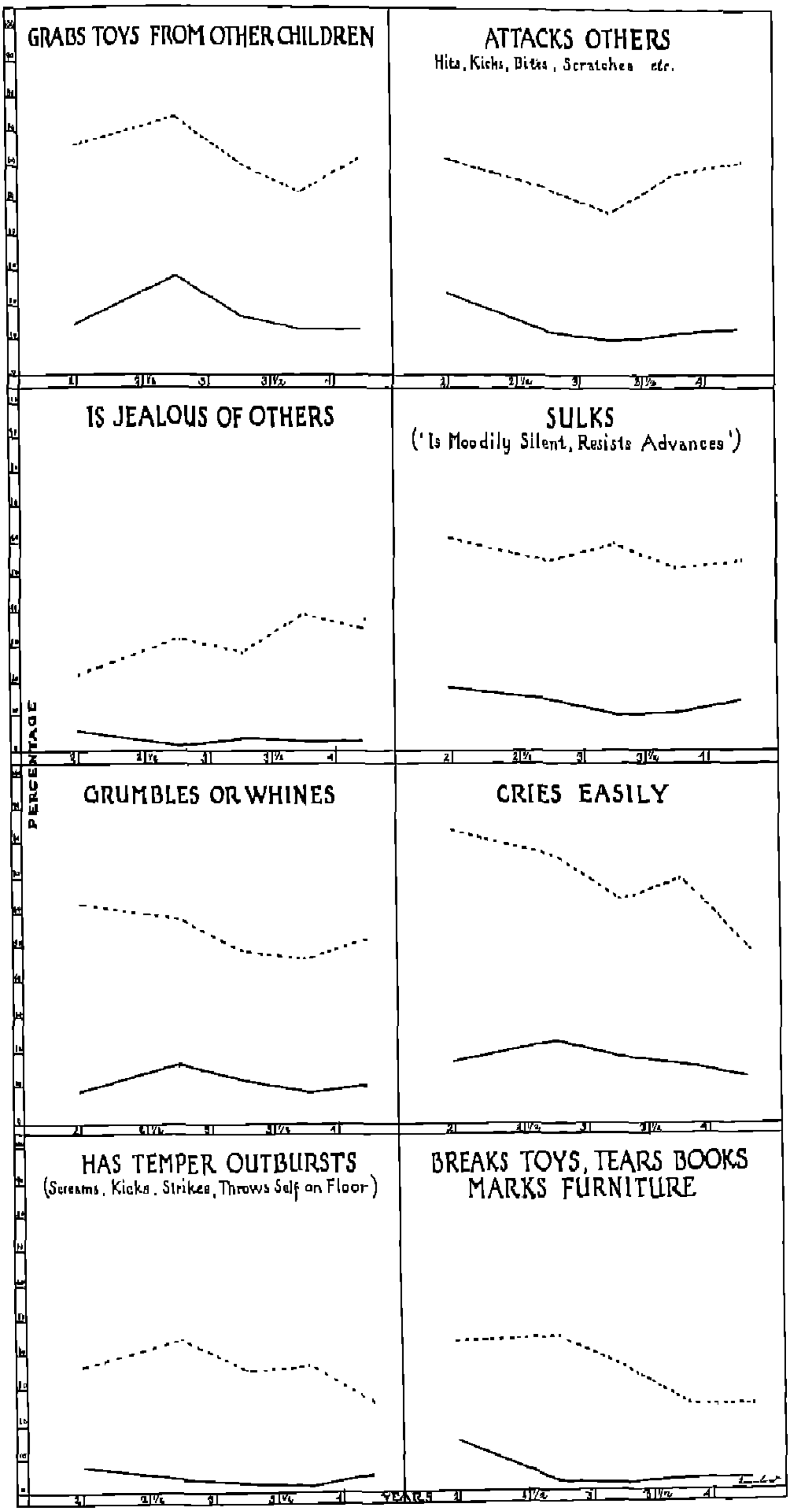
SHRINKS FROM NOTICE

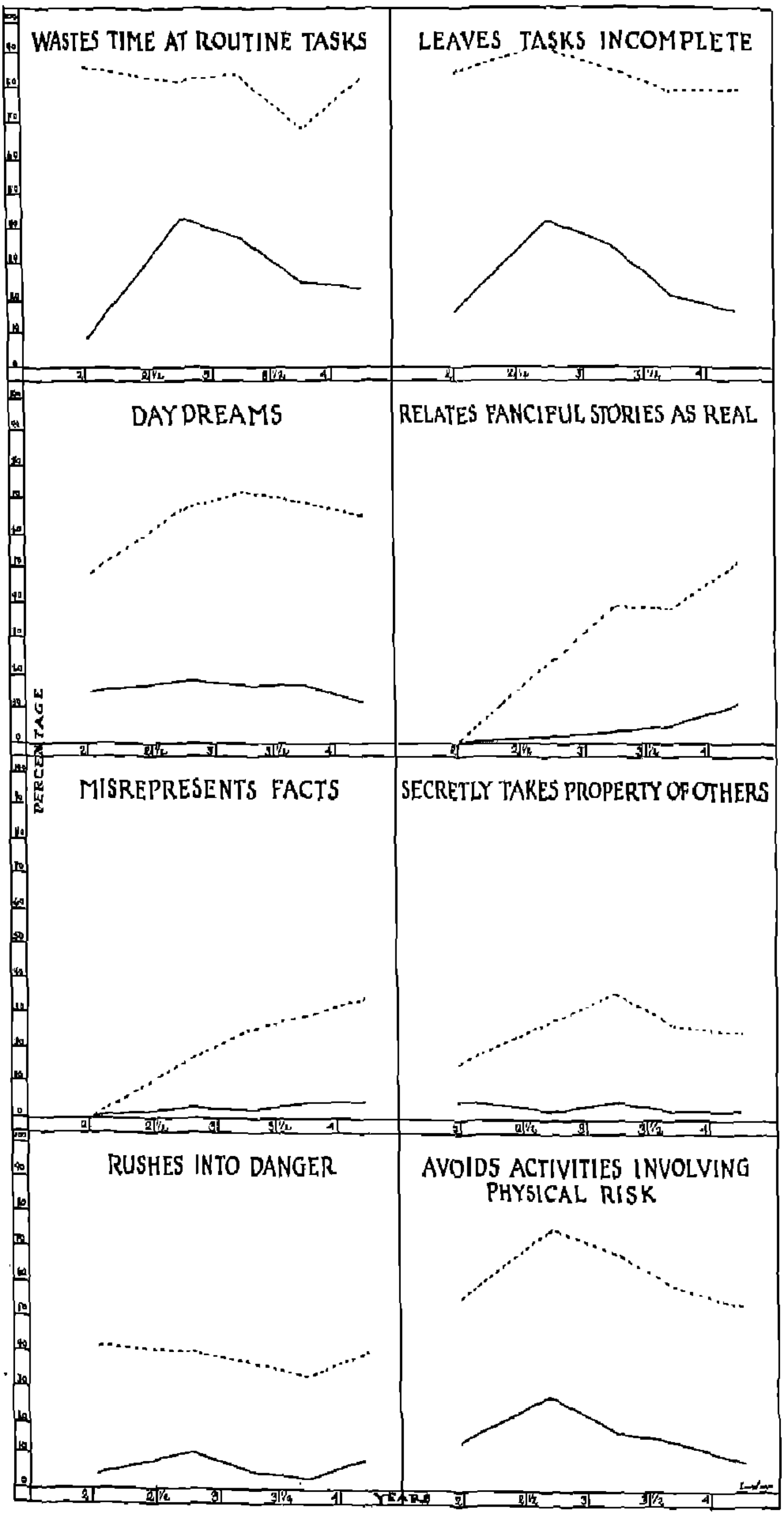
AVOIDS PLAY WITH OTHERS

BOSSES OTHERS

GIVES IN TOO EASILY

REFUSES TO SHARE OR TAKE TURNS


GRABS TOYS FROM OTHER CHILDREN
ATTACKS OTHERS
Hits, Kicks, Bites, Scratches etc.
IS JEALOUS OF OTHERS
SULKS
('Is Moodily Silent, Resists Advances')
GRUMBLES OR WHINES
CRIES EASILY
HAS TEMPER OUTBURSTS
(Screams, Kicks, Strikes, Throws Self on Floor)
BREAKS TOYS, TEARS BOOKS
MARKS FURNITURE
PERCENTAGE
2
2½
3
3½
4
YEARS


WASTES TIME AT ROUTINE TASKS
LEAVES TASKS INCOMPLETE
DAY DREAMS
RELATES FANCIFUL STORIES AS REAL
MISREPRESENTS FACTS
SECRETLY TAKES PROPERTY OF OTHERS
RUSHES INTO DANGER
AVOIDS ACTIVITIES INVOLVING PHYSICAL RISK
PERCENTAGE
0
10
20
30
40
50
60
70
80
90
100
2
2½
3
3½
4
YEARS

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(3) Hattwick, LaBerta Weiss: The influence of nursery school attendance upon the behavior of the preschool child. J. Exper. Educ., 1936, No. 2, 180-190.

CHANGES IN BODY PROPORTIONS DURING INFANCY AND THE PRESCHOOL YEARS: III. THE SKELIC INDEX

HOWARD V. MEREDITH AND VIRGINIA B. KNOTT[1]

As the title denotes, this is the third of a series of research papers dealing with changes in body proportions during infancy and the preschool years. The first paper (7) reported an investigation of the developmental course for the thoracic index during the postnatal period from three months to six years of age and gave a review of research literature on the trend of this index during prenatal life and between childhood and adulthood. The second paper (5) reported a study of the changing relation of width of hips to two major breadth measurements (shoulder breadth and breadth of thorax) and two major length measurements (stem length and length of lower extremities). Curves for each of the four indices, covering the first six years of postnatal life, were presented and discussed with reference to the so-called principle of "developmental direction."

PURPOSE

It is the purpose of this paper to report an investigation on the course of *the skelic index. The report will include (1) an analysis of skelic index distri*butions for successive quarterly and semiannual age intervals between birth and six years of age, (2) an examination of the trend obtained for the index in terms of the growth patterns for each of its component measurements, (3) a review of the trend of the index during prenatal life, and (4) a supplementary analysis of skelic index distributions for annual age intervals covering the postnatal period from seven to eighteen years.

MEASUREMENTS USED IN CALCULATION OF THE INDEX VALUES

The skelic index is defined as:

$$\frac{\text{Length of lower extremities X 100}}{\text{Stem length}}$$

In the present study, stem length was measured as vertex-rump length or sitting height, and length of the lower extremities was derived as stature minus stem length. On subjects under two years of age, stature was taken as vertex-sole length and stem as vertex-rump length. Both measurements were determined on the Baldwin Infant Measuring Board with the subjects in dorsal recumbency. Beyond two years of age stature was obtained in the erect standing position and stem as erect sitting height. The Baldwin Paper Measuring Scale and Square were used in taking both measurements, the head of the subject being oriented on the Frankfort Horizontal.[2]

DATA

The basic data consist of approximately 4,200 paired values for stature and stem length. These data were obtained from measurement of roughly

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[1] From Iowa Child Welfare Research Station, State University of Iowa, Iowa City, Iowa.

[2] A more detailed discussion of the method of measuring stature and stem length employed at the Iowa Child Welfare Research Station has been published by one of the authors elsewhere (6, 125).

CHILD DEVELOPMENT, Vol. 9, No. 1 (March, 1938)

1,100 infants and preschool children of both sexes.

Aside from 100 pairs of observations made on newborn infants, the data were obtained from physical measurement records made at the University of Iowa Infant laboratory, preschool laboratories, and elementary school. They represent observations accumulated on Iowa City children during the years 1929 to 1936 by the anthropometric staff of the Iowa Child Welfare Research Station. The children ranged in age between one month, fifteen days and six years, two months, thirty days. Many of them had repeated measurements over a period of two years or more. They were about equally divided as to sex.

In tabulating these data, each record was taken from the files in serial order. Those records were accepted for use that (1) fell between the age limits of one and one-half months and six years, three months, (2) carried paired values for stature and stem length, both taken either erect or recumbent, and (3) were not marked as applying to individuals of Negroid, Mongoloid, Jewish, or southwest European stock, or to individuals considered to lie outside the normal zone for physical build.

The 100 pairs of observations for newborn infants were gathered on fifty males and fifty females aged twenty-four to forty-eight postnatal hours. These neonatal values were obtained by Theodora H. Stebbins on full-term infants of American parentage born at the University Hospitals, Iowa City, during February and March, 1933.

Information on country of birth of the parents and grandparents and on the occupation of the father was available for approximately 60 per cent of the 1,100 subjects. Analysis of this material gave the following findings:

1. Both parents for more than 90 per cent of the subjects were born in the United States.
2. For around 65 per cent of the subjects, the parents and four grandparents were all born in the United States.
3. Roughly 30 per cent of the fathers were professional people and an additional 24 per cent were business proprietors, managers, or salesmen. Four per cent only were day laborers, while the remainder were about evenly divided between skilled trade employees, clerks and carriers, and university students.

The sample may be summarily characterized as being homogeneous with respect to geographic location, consisting of American-born children of northwest European ancestry, and representing a population heavily weighted with the professional and managerial classes.

In preparation of the basic data for analysis, it was first necessary to derive a figure for length of the lower extremities from each pair of values for stature and stem length. As already stated, the procedure employed was that of subtracting stem length from stature. Completion of this step gave upwards of 4,000 paired measurements for length of the lower extremities and stem length, and thereby permitted computation of 2,081 skelic index values for males and 2,100 skelic index values for females.

THE SKELIC INDEX DURING PRENATAL LIFE

Though the data of the present study do not extend into the embryonic or fetal periods, a brief review of the trend for the index during these periods constitutes a pertinent preface to our findings for the trend of the index in the early postnatal years.

The lower limb buds do not make their appearance until about the beginning of the fourth week of embryonic life. Consequently, the ratio of the length of the lower extremities to the length of body stem is zero prior to this age.

By the close of the second prenatal month the length of the lower extremities (derived as stature minus vertex-rump length) equals around 16 per cent of the length of the body stem (vertex-rump length). Figures and curves presented by Schultz (9) indicate that at 8-1/2 weeks menstrual age stature approximates 35.9 mm. and stem length 31 mm. These values yield 4.9 mm. as the length of the lower extremities and 15.8 per cent as an estimate of the skelic index.

The changing relation between the length of the lower extremities and the stem length during the fetal period (three to ten lunar months) has been studied by Schultz (9) and by Scammon and Calkins (8). Schultz finds lower limb length in percentage of stem length to be 32.4 at three lunar months, while Scammon and Calkins find it to be 38.9 at this age. At four, five, and six lunar months the findings for the two studies are almost identical. Means for stature and vertex-rump length obtained by Scammon and Calkins yield lower limb/stem ratios of 44.4 per cent at four months, 46.7 per cent at five months, and 47.7 per cent at six months. Corresponding ratios derived from charts for stature and vertex-rump length given by Schultz are 44.5 per cent at four months, 46.3 per cent at five months, and 47.0 per cent at six months.

Schultz finds the ratio of lower limb to stem to be the same at ten lunar months as at six lunar months. Specifically, his data give indices of 48 at six months, 49 at seven months, 47 at eight and nine months, and 48 at ten months. Scammon and Calkins' study, on the other hand, indicates a gradually rising index from six to ten lunar months. Ratios derived from their means for stature and vertex-rump length increase regularly from 48.3 at seven months to 49.3 at ten months.

Summary: Studies on embryos and fetuses indicate that the length of the lower extremities in percentage of the stem length is zero in the third prenatal week, roughly 35 at three lunar months, approximately 48 at six lunar months, and 48 or 49 at ten lunar months. These figures imply a rapid increase from the fourth week to the twelfth week, a decidedly less rapid increase between three and six lunar months, and little if any increase from six months to the termination of prenatal life.

THE SKELIC INDEX DURING INFANCY AND THE PRESCHOOL YEARS

The original data on the skelic index of infants and preschool children, as previously noted, consisted of 2,081 values for males and 2,100 values for females. These 4,181 indices were grouped into thirty-eight distributions, nineteen for each sex. In the case of each series, one distribution was made for the fifty neonatal indices; eleven distributions covered the successive quarterly intervals from one month, fifteen days to two years, ten months, fourteen days; and the remaining seven distributions extended over the consecutive semiannual intervals from two years, nine months to six years, two months, thirty days. This age allocation was followed so that the first distribution could be considered to fall "at birth" and so that the midpoints of the successive intervals would fall at even quarter-year ages up to three years and at regular half-year ages between three and six years.

Statistical constants obtained from analysis of the nineteen distributions in each series are given in Table 1. Figure 1 shows curves for the skelic index of males and females drawn to the two series of mean indices from Table 1. Inspection of the table and graph yields the following findings:

1. The mean skelic index at the beginning of postnatal life (24 to 48 hours following birth) is 51.7 for males and 51.4 for females. While the sex difference is slight, it is of interest to note that its direction is the same as

TABLE 1

SKELIC INDEX: LENGTH OF LOWER EXTREMITIES (DERIVED AS STATURE MINUS STEM LENGTH) IN PERCENTAGE OF STEM (VERTEX-RUMP) LENGTH

Mean Age Year	Mean Age Month	Cases	Mean	Standard Error of Mean	Standard Deviation	Range
				Males		
	0*	50	51.7	.46	3.22	44.5 to 59.5
	3	65	49.3	.46	3.75	41.6 to 57.5
	6	109	52.1	.35	3.67	43.0 to 62.0
	9	136	54.5	.26	3.09	47.0 to 61.5
1	0	152	57.1	.23	2.89	50.4 to 64.7
1	3	141	59.3	.22	2.67	51.8 to 65.1
1	6	118	61.0	.26	2.82	54.9 to 67.8
1	9	103	62.1	.25	2.56	55.4 to 67.7
2	0	108	63.9	.24	2.51	57.8 to 69.4
2	3	101	65.4	.24	2.39	59.6 to 70.6
2	6	94	67.2	.26	2.53	60.8 to 73.4
2	9	97	68.4	.26	2.59	62.1 to 75.2
3	0	119	69.7	.27	2.97	62.3 to 78.4
3	6	119	71.9	.27	2.90	64.1 to 80.1
4	0	113	74.1	.27	2.87	67.1 to 82.1
4	6	109	76.4	.27	2.78	69.0 to 82.6
5	0	114	78.2	.30	3.22	71.5 to 86.7
5	6	121	79.2	.25	2.77	71.7 to 87.1
6	0	111	80.9	.29	3.07	72.1 to 89.2
				Females		
	0*	50	51.4	.38	2.69	44.2 to 59.0
	3	51	49.5	.67	4.09	41.1 to 59.9
	6	106	52.9	.30	3.13	44.6 to 62.4
	9	116	55.4	.30	3.18	47.8 to 64.3
1	0	119	57.6	.27	2.95	50.9 to 65.8
1	3	108	60.1	.30	3.09	52.1 to 68.4
1	6	98	61.8	.30	3.02	56.1 to 69.4
1	9	87	63.8	.31	2.92	57.9 to 72.0
2	0	74	65.4	.32	2.75	59.6 to 73.5
2	3	74	66.9	.32	2.75	61.9 to 73.0
2	6	69	68.7	.31	2.58	63.8 to 76.2
2	9	74	70.1	.35	3.04	64.4 to 78.2
3	0	90	71.2	.30	2.80	64.9 to 78.3
3	6	133	72.9	.29	3.29	66.1 to 81.6
4	0	143	74.8	.27	3.27	68.1 to 83.0
4	6	146	76.4	.31	3.75	68.2 to 84.2
5	0	195	78.2	.25	3.56	69.6 to 87.0
5	6	185	79.4	.26	3.59	71.8 to 88.0
6	0	182	81.0	.26	3.48	71.3 to 90.1

*The statistical constants of this age are derived from data for fifty infants of each sex measured two days following birth.

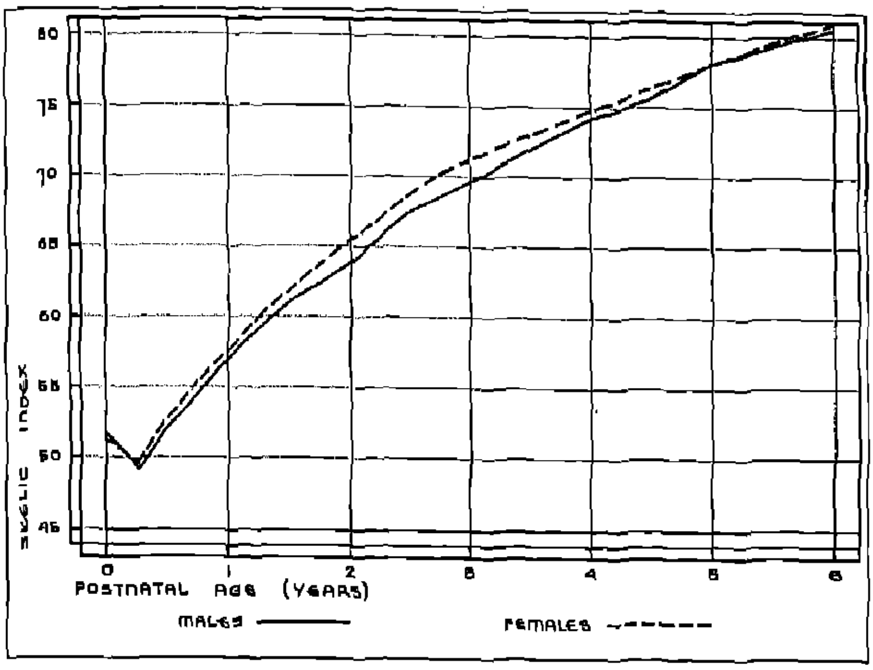

Figure 1. Skelic Index: Curves for the Age Period From Birth to Six Years Drawn to Mean Values From Table 1.

that obtained by Stockton-Hough (10). From an analysis of stature and stem length measurements made on 712 newborn, white infants, Stockton-Hough found the ratio of length of the lower extremities to stem length to approximate 53 for males and 52 for females. He concluded that female neonates have a longer stem in proportion to their lower limb length than do males.

2. *For both sexes, there is a definite decrease in mean skelic index between birth and three months of age.* Specifically, the index drops from 51.7 to 49.3 for males and from 51.4 to 49.5 for females. When aligned with research findings from other investigations, the validity of this decreasing trend appears open to question. On the one hand, Bayley and Davis (3) have reported means for stature and stem length (obtained from repeated measurement of thirty-one male infants and thirty female infants at monthly intervals between one month following birth and the end of the first year) which indicate that the skelic index decreases from approximately 54.0 at one month to 53.1 at three months in the case of males and from 53.1 at one month to 52.7 at four months in the case of females. On the other hand, there is not close agreement between the different studies as to the magnitude of the index at birth. Means for stature and stem length on newborn infants have been reported by Stockton-Hough (10), Taylor (11), and Bakwin and Bakwin (1). Estimates of skelic index at birth are roughly 53 for males and 52 for females (Stockton-Hough), 52 for males and 51 for females (the present study), 49 for males and 47.5 for females (Taylor), and 48 for each sex (Bakwin and Bakwin).

Further research is obviously needed to determine whether the skelic index decreases or remains constant during the first three months of postnatal life. It seems clear, however, that the length of the lower extremities does not increase in relation to stem length during this interval. On synthesizing the available findings for the early postnatal months and the findings for the fetal period, the probability is strongly suggested that additional research will establish the skelic index as remaining almost constant over the age span extending from the seventh lunar month of intra-uterine life to the third or fourth month of postnatal life.

3. There is a steady increase in mean skelic index from three months following birth to six years of age. The increase is from 49.3 to 80.9 for males and from 49.5 to 81.0 for females. Length of the lower extremities is thus equivalent to slightly less than one-half of stem length at three months of age and to somewhat more than 80 per cent of stem length by six years of age.

The rise in the index is greater between three months and three years than between three years and six years. For males, approximately 60 per cent of the rise from three months to six years takes place by three years of age. For females, the corresponding percentage is 69.

Bayley and Davis (3), Hejinian and Hatt (4), and Wallis (12) have reported findings for the stem-stature index over varying portions of the age intervals from three months to six years. Their means have been converted into values for the skelic index in order to obtain comparative material. Wallis' study gives skelic indices of roughly 58 at one year, 64 at two years, 74 at four years, and 80 at six years. These figures are all in close agreement with the figures of the present study. The values derived from Hejinian and Hatt are 64 at two years, 73 at four years, and 76 at five years, while those derived from Bayley and Davis rise from 53 at three months, through 56 at one year, to 66 at two years and 76 at three years. It will be noted that Bayley and Davis find less increase between three months and one year than is found in the present study. They write: "...the first year shows practically equal proportionate growth for the stem length and for the total length. It is only after the 12th month that the legs begin to grow rapidly ..."(12, p. 46).

4. At no age between three months and six years does the mean skelic index for males exceed that for females. On the contrary, the mean for females tends to surpass that for males throughout this period, while it is clearly and consistently higher than that for males from ages six months to four years, six months. It is thus found that at least between the latter half of the first postnatal year and the middle of the fifth year, the average female child has longer lower extremities relative to stem length than has the average male child. Wallis (12) obtained this same finding "between one and five years" and noted that the change to the relatively shorter stem length of the adult male must take place at a later age.

5. Variability in skelic index, as measured by the standard deviation, shows no consistent trend either toward increase or decrease during the first six years of postnatal life. There is a slight tendency, however, for variability to be greater in the first year and from four to six years than between the ages of one and four years. Sex differences in variability are not marked. On the whole, females show a tendency to be slightly more variable than males.

6. There is considerable overlapping of the distributions for any two successive age groups. This may be seen by reference to the "Range" column. The range for males at birth is from 44.5 to 59.5. The upper limit of this range is exceeded by roughly 4 per cent of the male cases at six months, 18 per cent of the male cases at one year, 65 per cent of the male cases at eighteen months, and 95 per cent of the male cases at two years. Thus the range of individual differences is such that there are children at two years of age whose skelic indices do not surpass those for other children at birth. Likewise, the proportionate relation between length of lower extremities and stem length is identical for a few children as young as two to two and one-half years and a few as old as six years.

GROWTH PATTERNS FOR THE COMPONENTS OF SKELIC INDEX

To further elucidate the trend of the skelic index during infancy and the preschool years, separate analyses were made for length of lower extremities and for stem length. The results of these analyses are shown in Tables 2 and 3 and in Figure 2. Findings for length of lower extremities are:

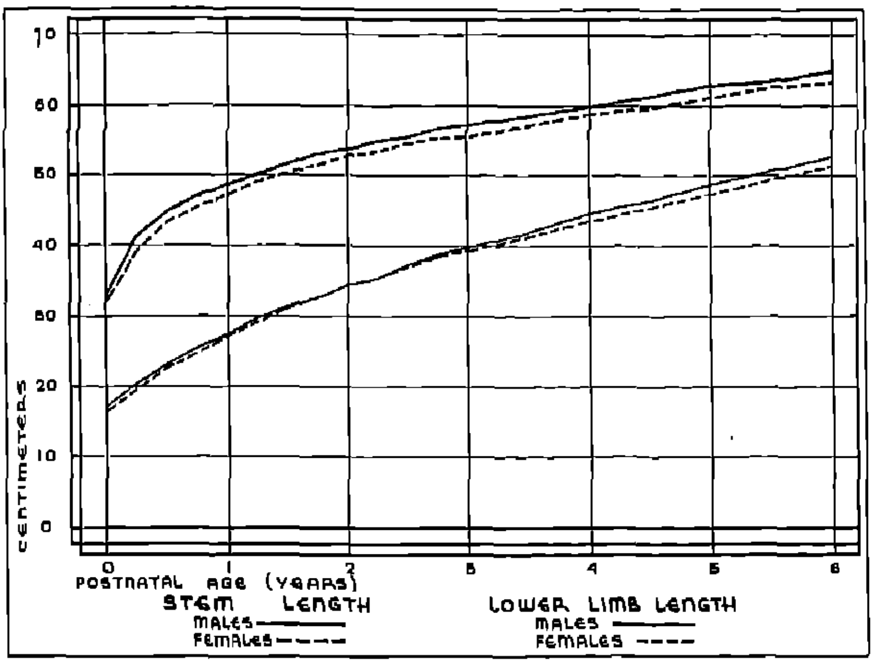

Figure 2. Stem Length and Lower Limb Length: Curves Drawn to Series of Means for Males and Females Given in Tables 2 and 3.

1. The mean length of the lower extremities for children six years of age is approximately three times as great as the corresponding mean for newborn infants. The exact values obtained are 17.1 cms. for males and 16.7 cms. for females at birth, and 52.5 cms. and 61.5 cms. for males and females respectively at six years of age.

2. The mean birth values for length of the lower extremities are doubled by two years of age for both males and females. Thus the absolute increase in lower limb length is as great during the first two postnatal years as during the succeeding four-year period.

3. In general the mean length of the lower extremities for males exceeds that for females over the first six years of postnatal life. At birth the difference approaches statistical significance, between eighteen months and four years of age it is negligible, while by six years it again approaches statistical significance.

4. The relative variability of lower limb length, as indicated by the coefficient of variation, is greater for the three-month distribution than for the distributions at any succeeding age. There is a slight tendency for the coefficient to decrease from six months and two years, six months and to show a mild increase between two years, six months and six years.

5. There is less overlapping of adjacent distributions for length of lower extremities than of adjacent distributions for stem length or for such dimensions as width and depth of the thorax (7). The lower limb length of every child studied at six months of age exceeded the maximum lower limb length obtained for newborn infants. The degree of overlapping of distributions, as one would expect, increases with age. This is illustrated by the fact that some six-year-old children were found to have lower limb lengths which did not exceed those of other children aged four years.

TABLE 2

LENGTH OF LOWER EXTREMITIES (CENTIMETERS): MEAN, STANDARD ERROR OF MEAN, STANDARD DEVIATION, COEFFICIENT OF VARIATION, AND RANGE VALUES FOR MALES AND FEMALES AGED BIRTH TO SIX YEARS

Mean Age Year	Mean Age Month	Cases	Mean	Standard Error of Mean	Standard Deviation	Coefficient of Variation	Range
				Males			
	0*	50	17.10	.13	.90	5.3	15.4 to 19.1
	3	65	20.23	.21	1.72	8.5	16.3 to 23.9
	6	109	23.26	.15	1.60	6.9	19.8 to 27.0
	9	136	25.31	.12	1.38	5.5	22.2 to 28.2
1	0	152	27.68	.11	1.37	4.9	24.3 to 30.7
1	3	141	29.57	.11	1.26	4.5	27.0 to 32.7
1	6	118	31.38	.14	1.49	4.8	27.9 to 35.2
1	9	103	32.69	.14	1.45	4.4	29.6 to 35.8
2	0	109	34.36	.15	1.67	4.6	30.0 to 38.1
2	3	101	35.72	.15	1.53	4.3	31.6 to 39.2
2	6	94	37.26	.15	1.47	3.9	33.1 to 40.9
2	9	97	38.60	.17	1.71	4.4	34.6 to 42.9
3	0	119	39.78	.17	1.85	4.7	35.0 to 43.5
3	6	119	41.90	.18	1.84	4.6	37.0 to 45.9
4	0	113	44.32	.18	1.90	4.3	39.2 to 49.1
4	6	109	46.18	.19	1.98	4.3	42.0 to 52.2
5	0	114	48.69	.22	2.34	4.8	42.5 to 54.1
5	6	121	50.32	.21	2.35	4.7	43.5 to 55.9
6	0	111	52.50	.26	2.70	5.1	46.4 to 58.6
				Females			
	0*	60	16.67	.11	.81	4.9	14.5 to 18.4
	3	61	19.66	.22	1.60	8.1	16.3 to 23.7
	6	106	22.74	.13	1.33	5.8	18.8 to 25.7
	9	116	25.04	.13	1.42	5.7	21.3 to 29.1
1	0	119	27.23	.13	1.43	5.3	23.8 to 30.8

TABLE 3

STEM LENGTH (CENTIMETERS): MEAN, STANDARD ERROR OF MEAN, STANDARD DEVIATION, COEFFICIENT OF VARIATION, AND RANGE VALUES FOR MALES AND FEMALES AGED BIRTH TO SIX YEARS

Mean Age Year	Mean Age Month	Cases	Mean	Standard Error of Mean	Standard Deviation	Coefficient of Variation	Range
				Males			
	0*	60	33.12	.20	1.43	4.3	30.1 to 38.0
	3	65	41.06	.24	1.90	4.6	36.0 to 45.4
	6	109	44.64	.15	1.68	3.5	41.1 to 48.9
	9	136	46.51	.14	1.59	3.4	43.2 to 51.2
1	0	152	48.47	.14	1.75	3.6	43.6 to 52.8
1	3	141	49.97	.15	1.77	3.6	45.6 to 54.3
1	6	118	51.40	.17	1.90	3.7	47.7 to 57.6
1	9	103	52.70	.19	1.91	3.6	48.6 to 56.8
2	0	109	53.75	.17	1.81	3.4	50.0 to 58.2
2	3	101	54.64	.17	1.73	3.2	51.0 to 59.0
2	6	94	55.46	.20	1.96	3.5	51.1 to 60.2
2	9	97	56.42	.19	1.92	3.4	52.1 to 61.4
3	0	119	57.15	.19	2.05	3.6	52.7 to 62.3
3	6	119	58.29	.19	2.05	3.5	54.3 to 64.6
4	0	113	59.86	.20	2.08	3.5	55.6 to 65.8
4	6	109	61.27	.21	2.18	3.6	55.6 to 67.0
5	0	114	62.35	.22	2.31	3.7	56.3 to 68.6
5	6	121	63.57	.22	2.37	3.7	57.8 to 70.1
6	0	111	64.92	.23	2.47	3.8	58.1 to 71.8
				Females			
	0*	50	32.49	.16	1.10	3.4	30.1 to 35.3
	3	51	39.73	.29	2.04	5.1	35.3 to 44.0
	6	106	43.11	.17	1.74	4.0	38.6 to 47.7
	9	116	45.29	.16	1.73	3.8	40.4 to 49.6
1	0	119	47.31	.16	1.71	3.6	43.2 to 51.8
1	3	108	48.99	.15	1.59	3.2	45.3 to 53.0
1	6	98	50.38	.15	1.51	3.0	47.1 to 54.3
1	9	87	51.62	.17	1.61	3.1	48.1 to 55.6
2	0	74	52.71	.19	1.62	2.9	49.1 to 56.6
2	3	74	53.39	.18	1.54	2.9	49.5 to 57.3
2	6	69	54.21	.18	1.53	2.8	50.8 to 57.6
2	9	74	55.02	.22	1.90	3.5	51.1 to 59.0
3	0	90	55.81	.19	1.85	3.3	51.5 to 61.0
3	6	133	57.22	.19	2.24	3.9	51.9 to 62.9
4	0	143	58.65	.18	2.13	3.6	53.3 to 64.7
4	6	146	59.90	.18	2.15	3.6	55.0 to 66.0
5	0	195	61.10	.15	2.16	3.5	56.1 to 67.5
5	6	185	62.62	.16	2.17	3.5	56.9 to 68.7
6	0	182	63.61	.18	2.46	3.9	58.0 to 70.0

*The statistical constants at this age are derived from data for fifty infants of each sex measured two days following birth.

3. Throughout the entire age span from birth to six years, mean stem length for males is greater than that for females. In general the males surpass the females by a definitely larger margin than in the case of length of lower extremities. Except at birth, the differences consistently exceed one centimeter and are statistically significant.

4. The coefficient of variation shows the same general trend as for length of lower extremities. The highest coefficient occurs at three months and there is a slight tendency for the successive coefficients to decrease to two years, six

TABLE 4

SKELIC INDEX: LENGTH OF LOWER EXTREMITIES (DERIVED AS STATURE MINUS STEM LENGTH) IN PERCENTAGE OF STEM (VERTEX-RUMP) LENGTH

Mean Age (Years)	Cases	Mean	Standard Error of Mean	Standard Deviation	Range
			Males		
7	207	82.90	.27	3.95	73.4 to 91.6
8	188	85.23	.25	3.49	75.2 to 95.0
9	180	87.42	.28	3.72	77.8 to 97.1
10	167	89.82	.31	3.98	79.7 to 101.4
11	165	91.15	.33	4.21	80.7 to 103.9
12	159	92.58	.35	4.38	81.9 to 103.8
13	171	93.94	.33	4.36	82.8 to 105.2
14	192	94.58	.33	4.63	84.7 to 105.9
15	211	93.92	.32	4.66	84.1 to 106.5
16	217	93.26	.30	4.48	82.2 to 103.9
17	193	92.30	.34	4.75	81.6 to 103.4
18	173	90.79	.33	4.30	81.5 to 101.5
			Females		
7	184	83.55	.26	3.56	74.8 to 93.2
8	190	85.91	.29	4.04	76.7 to 97.3
9	204	88.35	.30	4.28	76.8 to 100.4
10	212	89.95	.30	4.37	80.1 to 104.7
11	203	91.35	.32	4.54	80.4 to 105.1
12	203	91.70	.34	4.91	79.9 to 105.1
13	183	91.95	.38	5.14	79.5 to 104.2
14	184	91.16	.39	5.34	76.2 to 105.6
15	205	89.51	.33	4.74	77.0 to 105.0
16	183	88.44	.36	4.91	74.4 to 100.9
17	165	88.00	.38	4.85	74.5 to 100.2
18	110	87.70	.44	4.63	73.6 to 99.1

SUMMARY

The *skelic index*, defined as the percentage relation of length of lower extremities to stem length, is computed for approximately 4,200 paired measurements taken on upwards of one thousand children between birth and six years of age. *Length of lower extremities* is derived as stature minus stem (vertex-rump) length.

The indices are grouped into nineteen distributions for each sex and each distribution is analyzed for central tendency and variability. Findings for the index are presented in tabular, graphic, and descriptive form, and an attempt is made to elucidate these findings by examination of the growth patterns for the components of the index.

In addition to study of the skelic index and its component measurements during infancy and the preschool years, research findings on the proportionate relation between lower limb length and stem length during prenatal

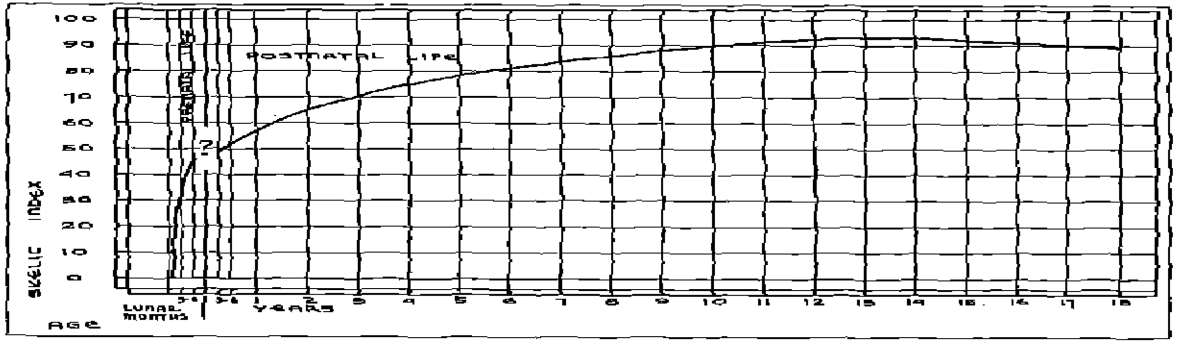

Figure 4. Skelic Index: Semischematic Curve Between One Lunar Month of Prenatal Life and the Eighteenth Postnatal Year.

life are reviewed and supplementary material is presented on the trend of the skelic index during the childhood and adolescent years from seven to eighteen.

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CONCEPTS OF CHILDREN AND COLLEGE STUDENTS EXPRESSED WITH 20 WORDS OF THE ACTION-AGENT TEST[1]

FRANK T. WILSON[2]

Forty-four five year old kindergarten children, 56 first grade children in the Horace Mann School, Teachers College, and 112 women students in the upper division of college were given the 20 action words shown in Table 1. The test was given to the children individually and their oral responses were written down by the examiner. The college students wrote their responses as the words were dictated to them in class groups.

ANALYSIS

The responses are shown in Table 1, word by word of the test, and in percentages for each group of subjects. Preceding each response in the table is the letter which refers to the category into which the response was placed for analysis according to the following classification:

a) correct and most common response
b) correct and generalized, broad or abstract response
c) correct and specific association, as a particular class of object or instance
d) correct and personal response
e) correct and childish expression
f) general and loose relationship, true in certain but not all respects
g) correct and of unusual or special meaning
h) incorrect response
i) phraseology

Exception may well be taken to some of the classifications made in the report. In explanation of the categories and the assignment of responses to them, the following arguments are given. First, the responses given most frequently by the college students were considered to be a) correct and most common. It seems logical to suppose that young adults would give the correct and most common responses to such common words as those of the test.

The category, f) general and loose, seemed necessary to provide for responses that in a way were correct, but upon careful consideration could not be called wholly correct. It was desirable to distinguish that sort of response from the category b) correct and generalized, broad or abstract. For example, the response "man" or "human beings", to What sleeps? is correct and generalized, while "everything" is general and loose, not strictly true. "People", "animals", "persons", "everybody" were classified general and loose, first because the strictly correct answer must be singular, and second, because the percentages were so much larger for the children than for the college students. As compared with these, the responses "man" and "human beings" (although the latter is plural instead of singular) are more abstract and generalized. It was felt that such differences in concepts, even if rather fine ones, should be brought out.

Another classification that may seem arbitrary was to put words made by adding "er" to the action word into the classification f) general and loose. For

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[1] This report presents a minor phase of a study of Reading Readiness and Reading Progress in the Primary Grades of the Horace Mann School, Teachers College, New York, 1933-1937. This study has been made possible by the cooperation of Miss Agnes Burke, Teacher of Grade I, and other teachers of kindergarten and primary grades. It has been made under the supervision of Doctor Cecile White Flemming, Director of Pupil Individual Development and Guidance, and of Doctor Rollo G. Reynolds, Principal. Prepared with the assistance of the U.S. Works Progress Administration, New York City, project number 65-97-295, sub-project 25.

[2] *From Hunter College, New York City.*

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TABLE 1

THE RESPONSES TO 25 ACTION WORDS MADE BY 112 COLLEGE STUDENTS, A, AND 100 CHILDREN, B, SHOWN IN PERCENTAGES, WITH THE CLASSIFICATIONS OF THE RESPONSES INDICATED BY LETTERS.*

1. stimulus word: sleeps

		A	B
a.	baby, babies	29.5	16
a.	child, children	16.1	6
f.	people, animals, persons, everybody	22.2	35
b.	man	11.6	1
b.	animal, a person	7.1	2
c.	girls, boys	3.6	12
b.	human beings	3.6	
c.	cows, cat, dog	3.6	9
f.	sleepers	3.6	
g.	doll	1.8	
b.	tired ones	.9	
b.	living being	.9	
b.	body	.9	
b.	organic substance	.9	
d.	we, ourselves, me, you, I may		5
c.	a lady, bird, horse, bear		4
d.	mothers and fathers		1
f.	everything		1
h.	beds		1
	no answer		5
		100.1	100

2. stimulus word: scratches

		A	B
a.	cat, cats	61.6	43
c.	nails, toes, needles, sandpaper	9.8	2
c.	dogs	8.9	6
c.	chickens, chicks, hens	7.1	9
c.	mice, rooster, rat	2.7	2
b.	bites	1.8	
g.	elastic	1.8	
h.	mosquito	.9	1
b.	claw	.9	
b.	all of animals	.9	
c.	finger	.9	
c.	tiger, lion, monkey, birds, bear, rat-bird, mole		8
a.	kitties, pussy, pussy-cat		4
f.	people, a person, children		3
f.	animals		2
c.	a knife, pens		2
c.	kitten		1
d.	I		1
g.	carpenters		1
h.	finger on desk		1
i.	something to walk on		1
h.	tree		1
	unknown	2.7	
	no answer		14
	Total	100	100

3. stimulus word: flies

		A	B
a.	birds	78.6	52
c.	a fly, flies	13.7	19
c.	bat, bats	4.5	3
e.	airplane	2.7	2
c.	mosquito	.9	
b.	time	.9	
f.	flier	.9	
h.	liar	.9	
c.	butterflies		10
c.	bees		4
c.	a bug		2
g.	angels		1
i.	black things with wings		1
e.	ball		1
c.	owl		1
	no answer		1
		100.1	100

4. stimulus word: bites

		A	B
a.	dogs	76.8	41
c.	wolf, cats, bear, etc	6.2	23
c.	teeth	3.6	
f.	animals	2.7	6
c.	mosquitoes	2.7	8
c.	insects	1.8	
c.	fleas, bug	1.8	
f.	children, man	1.8	
h.	bees	.9	2
h.	snake	.9	1
f.	biter	.9	
c.	lion, lions, tiger, tigers		13
c.	spiders, turtles		2
f.	people, everybody		2
d.	we and the lions		1
c.	your teeth		1
f.	wild animals		1
	no answer		1
		100.1	100

5. stimulus word: swims

		A	B
a.	fish	85.7	50
f.	a person, man, people	8.9	21
c.	ducks	1.8	6
f.	swimmer	1.8	
f.	girl, children	.9	7
c.	eel, sea-lion, frogs & turtle	.9	5
c.	dog, horses		3
c.	whale, elephant, hippo		3
d.	I		1
h.	somebody swims		1
i.	everybody in the water		1
f.	everything		1
	no answer		2
	Total	100	100

6. stimulus word: burns

		A	B
a.	fire	82.1	64
c.	wood, stick	8.9	12
c.	coal	2.7	
g.	dinner	1.8	
c.	paper	.9	3
g.	heat	.9	1
g.	sun	.9	
f.	burner	.9	
f.	stoves, ovens		7
g.	houses		3
g.	food		2
g.	car		1
h.	smoke		1
c.	embers		1
i.	we burn the food		1
g.	potato		1
g.	scraps		1
	unknown	.9	
	no answer		2
	Total	100	100

7. stimulus word: cuts

		A	B
a.	knife, knives	82.1	53
c.	scissors	12.4	19
c.	razor	2.7	1
b.	sharp blade	1.8	
f.	cutter	.9	
c.	saw, shears, axe, sword, lawn-mower		19
c.	glass		2
f.	man, men		2
h.	food		1
i.	when I fall on pavement		1
	no answer		2
	Total	99.9	100

8. stimulus word: blows

		A	B
a.	wind	85.7	70
c.	whistle	7.2	
c.	horn	3.6	5
f.	bubble	1.8	
f.	balloon	.9	3
g.	breath	.9	
i.	gun	.9	
g.	fire	.9	
c.	paper	.9	
f.	people		5
f.	air		4
c.	the mouth		3
f.	a boy		1
i.	babies a year old		1
i.	paper when the window is open		1
h.	lights		1
g.	dynamite		1
f.	pipes		1
	no answer		5
	Total	100	100

9. stimulus word: shoots

		A	B
a.	gun	91.0	86
c.	cannons	2.7	3
c.	pistols	2.7	
c.	firecracker	.9	
g.	arms	.9	
g.	star	.9	
f.	gunner	.9	
c.	arrow		2
f.	man		2
g.	roller-coasters		1
h.	horn		1
d.	fire		1
f.	people		1
c.	machine gun		1
	no answer		3
	Total	100	100

10. stimulus word: melts

		A	B
a.	ice	62.5	36
c.	butter	19.7	21
c.	snow	8.0	19
c.	ice-cream	5.4	17
c.	wax	1.8	2
b.	heat	.9	
c.	iron	.9	
f.	metal		1
f.	everything		1
c.	sugar		1
i.	fire melts from pipes		1
	unknown	.9	
	no answer		1
	Total	100.1	100

11. stimulus word: sails

	A	B
boat	65.2	68
ship	27.7	9
sail-boat	5.4	18
canoe	.9	
sailor	.9	
kite		2
no answer		3
Total	100.1	100

12. stimulus word: boils

		A	B
a.	water	95.5	23
b.	liquid	1.8	
f.	fire	1.8	
f.	boiler	.9	
c.	eggs, potatoes, soup, meat, milk, cereal, beans, carrots, chicken, fish		25
c.	food		15
c.	pot, kettle, tea-kettle, pans, cooking things		11
c.	hot water, tea		4
i.	things to eat, everything I eat		3
f.	stove		3
i.	all kinds of vegetables		1
i.	things on the stove		1
i.	things I cook		1
i.	put in hot water		1
h.	steam		1
	no answer		11
	Total	100	100

13. stimulus word: floats

		A	B
a.	ivory soap, soap, ivory	30.2	1
a.	wood, piece of wood, stick, board, log	37	22
c.	cork	9.8	
f.	persons, people	7.1	4
c.	water wings	5.4	
c.	ice	4.5	
c.	ships, steamer	3.6	3
c.	raft, rowboats, sail-boats, canoes, rowing boats	3.6	9
f.	man	2.7	1
c.	balloon	2.7	
c.	duck	1.8	1
g.	sponge	1.8	
c.	balsam	1.8	
g.	ball	1.8	
c.	boats	.9	28
c.	buoy	.9	
g.	apple	.9	
f.	me	.9	
h.	fin	.9	
g.	paper		4
i.	piece of paper, paper on water		3
h.	fish		3
f.	a boy, children		2
g.	tin, rubber		2
c.	dead fish		1
g.	birds		1
h.	stars in the water		1
i.	light things on the water		1
c.	pencils		1
c.	bark		1
h.	river		1
	unknown	.9	
	no answer		12
	Total	100.1	100

14. stimulus word: growls

		A	B
a.	dogs	56.2	11
c.	lion	17.0	39
c.	bears	17.0	20
c.	wolf	6.2	3
f.	animals	1.8	3
f.	growler	.9	
c.	tiger		9
h.	owl		3
f.	girl		1
i.	wild animals at people		1
	unknown	.9	
	no answer		12
	Total	100	100

15. stimulus word: stings

		A	B
a.	bees, bumble-bees	92.0	84
c.	mosquitoes, wasp, fly	3.6	3
c.	horse-fly	1.8	
g.	insect bite	.9	
g.	acid	.9	
b.	butterfly		2
c.	iodine		2
a.	bumble bee		2
g.	ants		1
h.	mercurochrome		1
h.	fire		1
g.	poison		1
	unknown	.9	
	no answer		4
	Total	100.1	100

16. stimulus word: gallops

		A	B
a.	horse	98.2	87
c.	pony		11
g.	children		1
	unknown	1.8	
	no answer		1
	Total	100	100

17. stimulus word: aches

		A	B
a.	toothaches, teeth	32.8	2
a.	a pain	26.7	8
a.	head	17.9	9
c.	back, leg, feet, finger, hand	8.0	1
b.	muscles, bones	4.5	
b.	body regions, body	2.7	
a.	sore, sore finger, wound	3.7	
a.	stomach	1.8	13
a.	tummy, belly		5
g.	people		3
i.	people if it hurts them		1
i.	when you get hurt		1
	unknown	.9	
	no answer		61
		100	100

18. stimulus word: explodes

		A	B
a.	dynamite	49.1	13
c.	gunpowder, powder	16.1	4
c.	bombs	8.9	8
c.	gasoline, gas, gases, gas engine	8.0	6
g.	cannons, gunfire, gun	4.5	6
c.	TNT	3.6	
a.	balloon	3.6	3
g.	furnace	1.8	
f.	steam	1.8	
g.	mine	.9	
c.	bubble	.9	
c.	fireworks	.9	
h.	fire		6
g.	cigar fire cracker		3
g.	chemical set, fires volcanoes		3
g.	bullet		2
g.	homes, houses		2
g.	gas tank, engine		2
i.	things that get on fire		1
i.	fire in a car		1
i.	food it burns		1
h.	water		1
i.	my daddy's office		1
	no answer		47
		100.1	100

19. stimulus word: roars

		A	B
a.	lion	67.0	44
c.	tiger, tigers	3.6	13
f.	animals, big animals	3.6	2
c.	ocean, Niagara Falls, waves, sea-waves	2.7	6
g.	fire, furnace	2.7	
g.	crowd, angry professor	2.7	
c.	cannon	1.8	
c.	wind, thunder, storms		6
c.	bear, beast, wolves		4
h.	whistles, boat		2
	no answer		7
		100.1	100

20. stimulus word: mews

		A	B
a.	cat	87.5	62
b.	cow	4.5	4
c.	kittens	3.6	10
g.	persons, child	1.6	
a.	pussy	.9	3
a.	pussy-cat		3
a.	kittie		2
h.	mules		1
	no answer		17
		100.1	100

*See page 63 for list of classifications by letter.

example a "sleeper sleeps", a "flyer flies", etc. Such responses could scarcely be called b) generalized, broad or abstract concepts. Nor did they seem to belong in the category c) correct and specific. For example, "sleeper", as a response to What sleeps?, should be distinguished from such concepts as "horse", "bird", etc.

The category, g) correct and of unusual or special meaning, seemed worth while distinguishing from c) correct and specific. For example, some "dolls", but not all, sleep: an "elastic" or "carpenters" may scratch, but such associations are of unusual instances.

The remaining classifications seem obviously proper and show, perhaps, points of interest in the comparison between the two groups.

FINDINGS

Table 1 shows the percentages of responses each group of subjects made according to groupings of their replies. All important details, it is believed, are shown in this table.

Table 2 summarizes Table 1 and brings out the main differences between the groups, according to the categories. The percentages of students and children *giving responses to each word are shown according to each classification.* At the bottom of each subdivision of the table is given the average percentages.

The greatest difference between the groups was in the proportion of correct and most common responses given. The college students gave on the average 75.16 per cent of such responses, as compared with 48.4 per cent by the children. The students gave higher percentages of these responses than the children in all but one instance. This was for the word sails, for which 68 per cent of the children gave "boat" as compared with 65.2 per cent of the college students. The word which produced the greatest difference was boils. Ninety-five and five-tenths per cent of the college students gave "water"; 23 per cent of the children. The ranges of this category of responses were 45.6 per cent to 98.2 per cent for the college students, and 11 per cent to 87 per cent for the children. This indicates considerably more varied responses for the children.

This greater variation of response by the children is indicated especially by category c) correct and specific. The children averaged 27.65 per cent of responses of this type, the students 16.5 per cent. The ranges were 1 per cent to 71 per cent and 0 per cent to 40.2 per cent respectively. Inspection of Table 1 shows particulars wherein the variations were found. First, the children tended to name more frequently than the students those agents given by both. For example, in response to What sleeps? 3.6 per cent of the students gave "girls" or "boys", and 12 per cent of the children; "cows", "cat", "dog" were given by 3.6 per cent of the students, by 9 per cent of the children. Second, the children tended to give other of these specific type of responses more frequently than the students. For example, to What sleeps? the students named no other specific responses not named by the children, but the children added the responses "a lady", "bird", "horse", "bear". For the word boils the students named no specific objects other than water, while the children named 10 varieties of food, 5 varieties of cooking utensils, 15 per cent said "food" and 4 per cent "tea" or "hot water."

Another considerable difference between the groups was in the omissions and incorrect responses made. Every college student responded to all the words, but there was an average of 10.9 per cent of no answers to the entire 20 words by the 100 children. The college students made an average of .59 per cent incorrect answers, the children, 1.8 per cent.

Phraseologies gave averages of 1.45 per cent and 0 per cent, respectively, for children and students; personal responses, .45 per cent and .05 per cent;

TABLE 2

PERCENTAGES OF RESPONSES ACCORDING TO CATEGORIES

Responses

College Students

Stimulus Word	a Most common	b Generalized	c Specific	d Personal	e Childish	f Loose	g Unusual	h Incorrect	i Phraseology	Unknown	Total
sleeps	45.6	27.7	7.2			17.8	1.8				100.1
scratches	61.6	1.8	29.4				1.8	2.7		2.7	100
flies	78.6	.9	18.8			.9		.9			100.1
bites	76.8		16.1			5.4		1.8			100.1
swims	85.7		2.7			11.6					100
burns	82.1		12.5			.9	3.6			.9	100
cuts	82.1	1.8	15.1			.9					99.9
blows	81.2		13.4			3.6	1.8				100
shoots	91.0	.9	6.3			.9	.9				100
melts	62.5	.9	35.8							.9	100.1
sails	65.2		33.1			.9		.9			100.1
boils	95.5	1.8				2.7					100
floats	47.2		35.9	.9		9.8	4.5	.9		.9	100.1
growls	56.2		40.2			2.7				.9	100
stings	92.0		5.4				1.8			.9	100.1
gallops	98.2									1.8	100
aches	81.2	7.2	8.0				2.7			.9	100
explodes	49.1		38.4			1.8	10.8				100.1
roars	83.0		8.1			3.6	5.4				100.1
mews	87.5		3.6		.9		3.6	4.5			100.1
Average	75.16	2.15	16.50	0.5	0.5	3.18	1.94	0.59	0	0.50	100
Children											
sleeps	24	3	25	6		36		1		5	100
scratches	40		30	1	4	5	1	2	2	15	100
flies	52		44		1		1		1	1	100
bites	48		34	1		9		3		5	100
swims	50		19	1		25			2	3	100
burns	64		16			7	9	1	1	2	100
cuts	53		41			2		1	1	2	100
blows	70		7			14	1	1	2	5	100
shoots	86		6			3	2	1		2	100
melts	36		58			2			1	3	100
sails	68		29							3	100
boils	23		55			3		1	7	11	100
floats	23		44			7	7	4	5	10	100
growls	11		71			4		3	1	10	100
stings	84		5		1		2	4		4	100
gallops	87		11				1			1	100
aches	28		1		5		3		2	61	100
explodes	13		18				21	7	4	37	100
roars	46		29			2		2		21	100
mews	62		10		6			5		17	100
Average	48.4	0.15	27.65	0.45	0.85	5.95	2.4	1.8	1.45	10.9	100

childish terms .85 per cent and .06 per cent. Examples of phrases given by the children were: "finger on desk", "something to walk on", scratch; "black things with wings" fly; "everybody in the water" swims, etc. The only personal response by college students was "me" to the question What floats? Some of the children's personal responses were: "we", "I may", "we do", "ourselves", etc. Childish terms were such as "pussy-cat", "bungle-bee", "butt", etc. It is interesting to note that the children used very few of these kinds of responses. It seems somewhat surprising that only two college responses were of these three kinds.

The students gave an average of 2.15 per cent generalized concepts, the children .15 per cent. Most of the action words precluded the probability of a generalized concept as defined in the classification used. This kind of response was given by the students to only 8 of the 20 words. The only one on which the children made such a response was sleeps. One child answered "man", another "animal", and a third "a person". In contrast 27.7 per cent of the students gave a general concept in response to this word. The difference on this response is probably more representative of the two groups than that of the test as a whole.

The concepts classified as "general and loose" showed averages of 5.95 per cent for the children and 3.18 per cent for the students.

The remaining category, g, unusual or special in meaning, shows about the same averages for each group, 1.94 per cent for the college students, 2.40 per cent for the children. For both groups this type of response shows particular experiences wherein, presumably, the associations were made. On the whole the associations of the college students suggest mature as compared with childish experiences. For example, the students gave such replies as "dinner", "heat", "sun" burn; "breath" and "fire" blow; "star" shoots; "sponge", "ball", "apple" float; etc. The children replied "carpenters" scratch; "angels" fly; "houses", "car", "potato", "scraps" burn; "roller coasters", "fire" shoot; etc.

SUMMARY

On a test of 20 action-agent words 1) as compared with college students children of kindergarten and grade one showed: a) a lesser percentage of most common and of generalized concepts; b) a greater variety of specific concept responses; c) a greater percentage of personal, general and loose, and incorrect concepts; d) a greater percentage of childish terms and phrases; e) about the same percentage of unusual or special meanings, which, however, tended to be indicative of child rather than adult experiences. 2) College students showed an appreciable percentage of general and loose, and of incorrect responses to these familiar words.

STUDIES IN FETAL BEHAVIOR: II. ACTIVITY OF THE HUMAN FETUS IN UTERO AND ITS RELATION TO OTHER PRENATAL CONDITIONS, PARTICULARLY THE MOTHER'S BASAL METABOLIC RATE

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We have suggested in an earlier publication that under normal conditions two measures of behavior may be made during fetal life, those of the fetal heart beat and of fetal movement. Heart rate measurements were discussed in this publication; it is the purpose of the present paper to deal with the measurement of fetal activity, and of its use as a criterion of individual differences in behavior. The problem is not a new one, having been of popular interest always in connection with childbirth, and of experimental interest at least since the study of Hicks (1) in 1880. Hicks and later Ray (4) and Sontag and Wallace (8) sought to measure movements objectively by using arrangements of membranes fastened over the mother's abdomen in such a way as to be sensitive to movements transmitted through the abdominal wall. In the last mentioned study, it was suggested that although the use of such instruments was undoubtedly more objective, it was perhaps less accurate than simply utilizing the mother's report of activities as she noticed them. Beside an increased sensitivity of the mother's report technique, there is the additional advantage that records may be made over much longer periods of time since the mother is in no way hampered in her movements by the encumbrance of apparatus.

Obviously the use of the mother's report has definite handicaps from the viewpoint of scientific method. We know nothing of the maternal threshold for noticing fetal movement, of the extent to which a given mother's reliability of report may vary, or of the nature of the discrimination required. How often may fetal movements seem to be intestinal movements, or vice versa?

The one direct method of checking the mother's accuracy--that of taking mechanical or observational records simultaneously with the mother's report--may be supplemented by other indirect methods. We may check the mother's accuracy in other types of report, test her sensory thresholds (for example, tactual sensitivity in the abdominal region). Another method is to determine whether or not the mother's report is correlated with an external factor more obviously related to fetal activity than to mother's reliability. In the present report the last mentioned validation has been used. It is clear, however, that much needs to be understood about the reliability of the mother's report over and above what we know at present. To this end we hope to study the factor of mother's sensitivity to fetal movement as a psychophysical problem of itself.

Subjects. Seventeen mothers were used in these studies of fetal activity. The numbers of records per mother varied from one to seventeen. Records were taken during the last twenty weeks of pregnancy, and for most subjects represented a fairly regular time sampling.

Method. Mothers reported to the laboratory usually either weekly or biweekly for periods of from five to six hours. They came at about 9 to 9:30 A.M. and stayed until 2:30 or 3 P. M. During this period, excepting for visits to the bathroom, they remained in bed, where they were served lunch and were permitted to read, sew, manicure, or converse as they chose. Everything was done for the mother to make her feel comfortable and relaxed. On a few occasions records of fetal heart rate, or physical examination by the Fels physician were allowed to interrupt this schedule, the mother remaining in bed none the less.

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Two pushbuttons were manipulated by the mother; one recorded movements of the fetus as the mother noticed them, the other was used to indicate her own activity. A signal system was devised for this second button, so that the mother pushed it twice for bathroom, four times for reading, five for sewing, etc. One push indicated the end of any type of maternal activity. Instructions were carefully given to the mother as to the signal system so that its detail was clear to her.

A polygraph was used for recording the signals. In addition to a magnet for each pushbutton, a third magnet was used as a time-line, indicating minutes. Since the study was to cover relatively long time samples, the unit of measurement was minutes active; any movement reported by the mother during a single minute was sufficient for it to be treated as an active minute. The use of minutes active rather than number of movements per unit time eliminates the problem of discreteness of movements, but it is well to realize that the minutes active criterion *is not an index of absolute amount of activity. Actually,* the measurement secured should be thought of as the minutes during which, according to the mother, the fetus seemed to be at all active.

Ten minute periods were selected as units for the ratios of minutes active since they were sufficiently short to make possible comparisons throughout the day.

Thirty-two records, including records for all individuals and representing the whole period of pregnancy studied, were re-read to determine the actual number of movements reported by the mother. Scores for these records in terms of movements per minute were correlated with the scores in terms of minutes active per ten minutes. The Pearson coefficient of correlation obtained was .93 ±.015, indicating that the minutes active criterion of activity used in this study was a good index of the absolute number of movements reported by the mother.

To determine the reliability of the technique for reading the polygraph records taken, fifteen records were read independently by two persons. The percentage of agreement between these two determinations of minutes active per ten minute period was 95.0 per cent. The percentage of agreement for number of single minutes active was 99.5 per cent. Between the two readings of time spent in different maternal activities the agreement was 91.8 per cent. The two sets of means calculated for the fifteen records showed a rank difference correlation of .99 ±.004.

RESULTS

INDICES OF ACTIVITY[2] FOR INDIVIDUALS AND FOR THE GROUP

In Table 1 are presented the individual and group means and standard deviations of number of minutes active in ten minute periods throughout the day, for all records. It is obvious that by moving the decimal place one point to the right, the units in Table 1 could be considered percentage of time active.

Means and standard deviations of activity scores for the entire group of seventeen individuals are summarized in Table 2. It will be seen that there is a tendency for activity to rise to a peak at about the eighth to ninth month, dropping off after that point. This tendency is not simply an expression of sampling error, as will be indicated by examination of individual graphs for activity presented in Figure 1. However, all individuals do not show this

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[2] The terms "activity" or "minutes active" hereafter will be used to indicate activity as reported by the mother.

TABLE 1

MEANS, STANDARD DEVIATIONS (SIGMA), AND NUMBERS OF 10 MINUTE PERIODS OF OBSERVATION, FOR MINUTES ACTIVE PER 10 MINUTE PERIOD DURING VARIOUS MONTHS OF PREGNANCY

Subject	Days before birth	Mean	Sigma	Number	Days before Birth	Mean	Sigma	Number	Days before Birth	Mean	Sigma	Number	Days before Birth	Mean	Sigma	Number	Days before Birth	Mean	Sigma	Number
1	2	2.76	2.38	33	37	2.87	2.67	31	72	1.65	1.86	34	86	2.22	2.52	32				
	9	2.00	1.58	28	44	3.42	2.61	31	79	1.58	1.64	31	93	2.74	2.03	31				
	16	1.68	1.69	31	51	2.43	2.23	14					99	2.00	1.77	35				
	23	2.11	2.20	27									107	2.12	1.85	33				
	25	3.07	1.67	14									111	2.13	1.87	30				
Mean	15	2.32	1.90	26.6	44	2.91	2.50	25.3	75.5	1.62	1.75	32	99.2	2.24	2.00	32.2				
2	12	2.94	2.31	17	40	3.43	2.21	28	68	2.65	2.37	20	96	4.16	2.34	19	127	1.84	1.95	19
					52	3.10	2.47	20					110	3.09	2.50	11				
					54	3.17	2.46	23												
Mean	12	2.94	2.31	17	48.7	3.23	2.38	23.7	68	2.65	2.37	20	103	3.62	2.42	15	127	1.84	1.95	19
3	2	2.89	1.69	18	38	2.77	2.60	31	59	3.19	2.42	36	87	3.69	2.61	36	117	2.70	3.00	20
	7	3.94	2.73	16	45	3.69	2.47	36	67	2.72	2.45	36	96	2.70	2.01	37	122	2.42	2.50	26
	16	2.85	2.76	27	52	3.76	3.08	29	73	4.03	2.59	30	112	2.20	2.11	30				
	23	3.26	2.58	23																
Mean	12	3.22	2.44	21	45	3.41	2.70	32	66.3	3.31	2.47	34	98.3	2.86	2.24	34.3	119	2.56	2.75	23
4	5	1.78	1.23	18	33	3.14	2.60	36												
	22	2.26	2.10	35	39	3.36	2.71	36												
	26	2.14	1.93	28	43	4.13	2.71	32												
					47	3.53	2.52	36												
Mean	17.7	2.06	1.75	27	40.5	3.52	2.64	35												
5	15	4.89	2.25	36	43	6.64	2.64	22	57	6.22	2.36	36	92	6.32	2.57	37	113	4.86	2.29	37
									78	6.77	2.56	26	106	5.94	2.19	36				
Mean	15	4.89	2.25	36	43	6.64	2.64	22	67.5	6.50	2.46	31	99	6.13	2.38	36.5	113	4.86	2.29	37
6	4	1.38	4.22	29	32	1.75	1.86	32	59	1.86	2.14	31	90	2.37	2.07	31	117	.64	.96	31
	18	1.26	1.20	32	45	2.57	2.60	28	76	2.71	1.91	31	97	1.40	1.85	25	124	.90	1.20	31
													103	1.71	2.26	35				
													110	1.00	1.49	19				
Mean	11	1.32	2.71	30.5	38.5	2.16	2.23	30	67.5	2.28	2.02	31	100	1.62	1.92	27.5	120.5	.77	1.08	31
7	26	.70	1.15	27																
Mean	26	.70	1.15	27																
8	3	3.79	2.31	29	31	4.96	2.37	27												
	17	3.53	1.81	32	55	4.16	2.74	32												
	28	3.64	2.92	31																
Mean	19.3	3.65	2.35	30.7	43	4.56	2.56	29.5												
9	1	.90	1.08	30	30	2.25	2.36	36	58	4.36	2.72	36								
	9	1.38	1.57	26	35	1.30	1.60	27	65	3.06	2.29	36								
	16	1.61	1.55	36	44	2.24	2.19	33												
	21	1.72	1.84	32	51	3.34	2.16	35												
Mean	11.8	1.40	1.51	31	40	2.28	2.08	32.8	61.5	3.71	2.50	36								
10	7	3.10	2.08	31	35	2.39	2.31	33	63	2.86	2.24	36	91	2.33	1.72	36				
	21	4.29	2.85	34	42	3.21	1.90	34	70	3.16	2.72	37	98	3.14	2.32	36				
					49	4.24	1.97	33	77	4.32	2.46	37	105	2.78	2.26	37				
					56	3.15	2.47	27	84	3.55	2.04	31								
Mean	14	3.70	2.46	32.5	45.5	3.25	2.18	31.8	73.5	3.47	2.36	35.2	98	2.75	2.03	36.3				
11	14	6.27	2.77	22	33	4.91	2.62	23	61	3.68	2.80	31								
	28	5.41	3.45	22	42	3.21	2.47	28												
					54	4.60	3.24	30												
Mean	21	5.84	3.11	22	43	4.24	2.78	27	61	3.68	2.80	31								
12	20	2.09	1.83	33					74	.83	1.37	23	101	1.07	1.10	14				
									84	1.62	1.41	24								
Mean	20	2.09	1.83	33					79	1.22	1.39	23.5	101	1.07	1.10	14				
13	7	2.33	1.49	33	41	2.16	1.83	31												
	14	3.27	2.76	11	55	1.41	1.06	32												
	28	2.18	1.68	33																
Mean	16.3	2.59	1.98	25.7	48	1.78	1.44	31.5												
14	5	4.53	2.32	30	33	2.81	2.02	32	68	5.06	2.55	31								
	19	3.93	2.56	30	40	4.07	2.83	29												
	26	4.16	2.88	25	47	2.33	1.88	30												
Mean	13.3	4.71	2.59	28.3	40	3.07	2.23	30.3	68	5.06	2.55	31								
15	1	5.56	2.46	27	32	3.38	2.66	32	58	4.31	2.65	26	86	4.13	2.55	31	114	2.27	1.90	30
	11	4.56	3.12	16	37	5.06	2.65	31	65	4.19	2.55	32	107	2.52	2.09	31	129	2.00	1.54	37
	18	3.56	2.92	32	44	4.25	2.87	32	71	4.97	3.41	33					137	1.35	1.36	26
	25	3.00	1.86	34	51	5.23	2.52	28	78	4.42	2.70	31								
Mean	13.8	4.17	2.59	27.2	41	4.48	2.68	30.8	68	4.47	2.83	30.5	96.5	3.32	2.32	31	127	1.87	1.60	31
16	10	2.52	2.06	25	31	3.00	2.44	30	61	3.55	2.45	31	87	3.71	2.56	31	115	2.86	2.72	22
	17	2.84	2.41	31	45	4.97	2.71	31	73	3.65	2.17	29	101	3.76	3.13	25	129	1.72	1.89	22
Mean	13.5	2.68	2.24	28	38	3.98	2.58	30.5	67	3.60	2.31	30	94	3.74	2.84	28	122	2.29	2.30	22
17	20	2.97	1.66	34	29	3.54	2.62	28												
					35	3.89	2.46	36												
					46	3.84	2.51	25												
					56	4.59	3.10	34												
Mean	20	2.97	1.66	34	41.5	3.96	2.67	31												

TABLE 2

SUMMARY OF ACTIVITY SCORES

Month	Number of Subjects	Mean	Standard Deviation
Sixth	6	2.36	1.24
Seventh	9	3.04	1.38
Eighth	12	3.46	1.40
Ninth	15	3.56	1.15
*Tenth	16	3.13	1.20

*This includes the one record on subject 7. Since she was considered only in the last month, she was eliminated from this month to month comparison. Her mean activity score was very low, .70.

tendency. Subjects 1, 11, 14, and 15 definitely showed a rise in the activity curve in the last month.

Variation within the group is relatively constant throughout the last months of fetal life. There is a tendency for it to drop in the ninth month, which fact is impossible of explanation at this point. It may be due to some factor of sampling. Deviations for individuals (Table 1) show, when averaged, the same tendency as does the group mean. Variation within the individual from record to record tends to increase slightly, and to drop off in the last month. These differences are insignificant, however.

RELATION OF FETAL ACTIVITY TO MATERNAL ACTIVITY

A comparison of the scores for fetal activity during periods when the mother was reading, sewing, lunching, and unoccupied yielded statistically significant differences only between lunch and other periods. In order to control the influence of age, fetal activity during only the last two months was used in these comparisons. Fetuses seemed equally active when the mother was occupied in any way but eating; during the lunch period they were reported as significantly less active. The most likely explanation of this finding is either that the mother's attention is more distracted from fetal movement by eating than by reading, sewing, or any other activity, or that some postural accompaniment of eating in bed is important in reducing the amount of activity reported. An approximation of the posture required for eating in bed--sitting up--is used for sewing, manicuring, writing, and also to some extent in reading. However, from observation, it appears that the mother's posture is more erect for eating than for any other activity. A suggestion from our work to date is that our methods of recording maternal activity in these broad and unqualified categories is too gross to pick up any relationships between maternal and fetal activity which may exist. We hope in later studies to measure features of maternal posture, fatigue, excitement, and the like in an attempt to correlate these more accurately with fetal activity. At present it is unwise to conclude that maternal activity is demonstrably effective in modifying fetal activity.

RELATION OF FETAL ACTIVITY TO TIME OF DAY

A careful analysis of all records in terms of time of day yielded no consistent covariation. There was a tendency for activity to show only a drop during the mother's lunch period, which drop we have discussed above in connection with maternal activity. It is possible, of course, that fetal activity may show some tendency to diurnal or other rhythm which our technique does not suffice to demonstrate. However, the work of Irwin (2) and others with

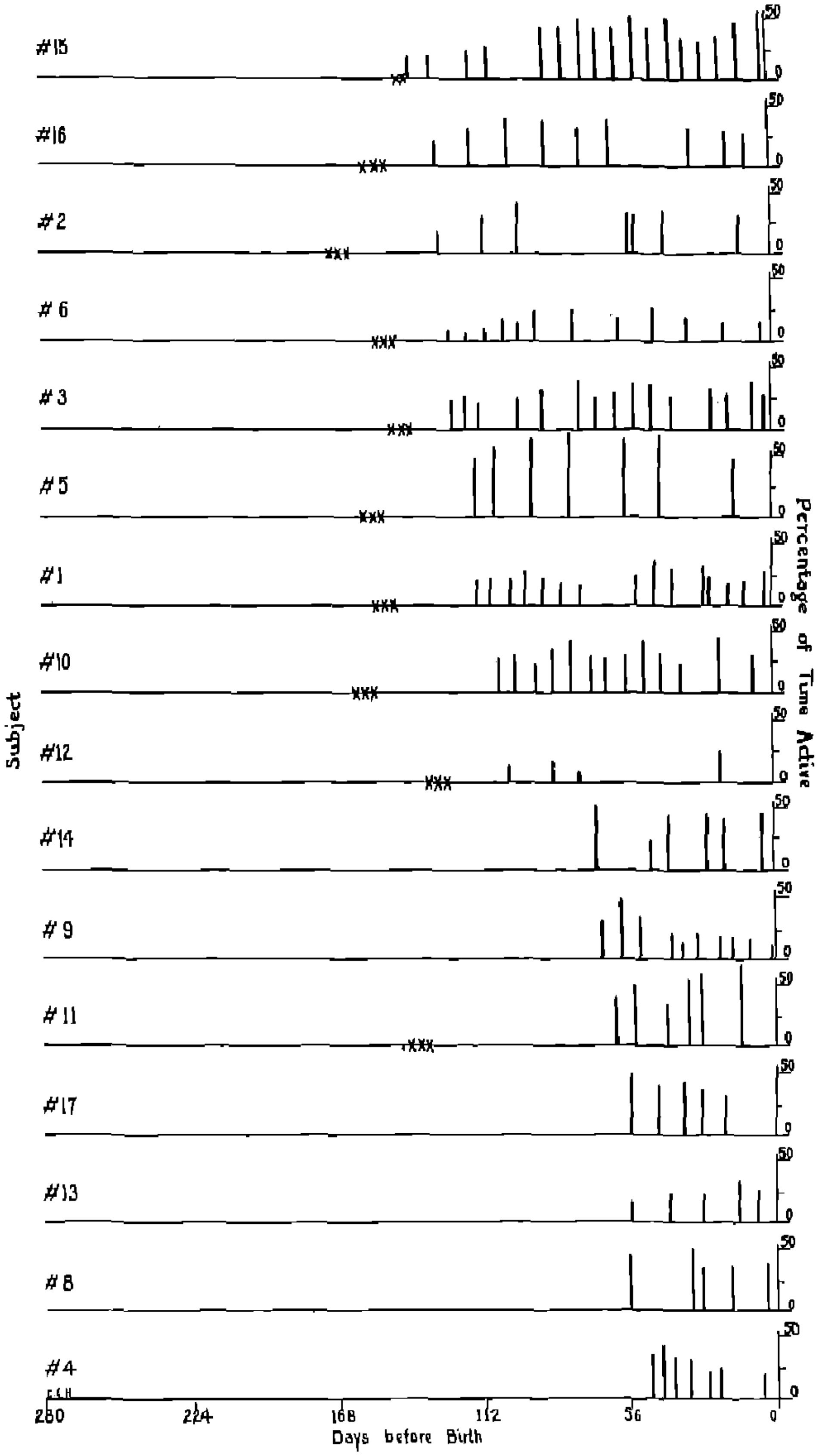

Figure 1.-Bar charts for individual fetuses illustrating the percentages of time active for different days during pregnancy. xxx denotes period during which movements were first noticed by the mother.

newborn infants indicates that diurnal rhythm does not appear until the regular feeding schedule is established. This evidence has been reviewed by one of us (6). Considering these findings with the newborn infant we should expect a diurnal rhythm of fetal activity perhaps only in connection with any such rhythm of the mother. Diurnal rhythm of fetal activity, if it exists, would very probably arise on the basis of nutrition, and considerable evidence suggests that under conditions of adequate supply the absorption of food by the fetus tends to be regular rather than periodical.

FETAL ACTIVITY AND THE MOTHER'S BASAL METABOLIC RATE

It is generally well accepted that the basal metabolic rate, BMR, increases for the average woman during pregnancy. That is, the mother's metabolism increases over and above what would be expected on the basis of weight gain alone.

For all mothers studied in this group basal metabolic rate determinations were made by means of the closed system (respiratory) method. The Sanborn Motor Graphic apparatus and Mayo Clinic norms (7) were used in obtaining rates. In this analysis, three new cases were added to increase the size of the group.

In Table 3 appear the ages, heights, weights, and BMR's for nineteen mothers. It will be seen that nine had determinations three times during pregnancy, eight had two, and two subjects had but one.

TABLE 3

MATERNAL AGES AND HEIGHTS; PRENATAL AGES*, WEIGHTS, AND BASAL METABOLIC RATES (BMR) DURING PREGNANCY

Subject	Age	Maternal Height (cm.)	Prenatal Age* (days)	Maternal Wt. (Kg.)	BMR	Prenatal Age (days)	Maternal Wt. (Kg.)	BMR	Prenatal Age (days)	Maternal Wt. (Kg.)	BMR
1	27	155	198	59.0	- 1.0	111	64.0	+ 6.5	18	70.8	+13.9
2	30	162	128	58.0	- 7.5	117	59.4	- 6.5	25	63.0	+22.2
3	15	**	114	46.0	+ 3.6	87	50.8	+ 5.0	31	56.9	+15.1
5	30	152	196	52.2	-19.3	112	56.7	0.0	20	64.0	+12.6
6	26	161	202	45.4	+ 8.9	99	52.2	+ 1.1	11	55.8	+ 6.2
10	25	171	190	59.4	- 8.2	108	63.5	- 3.3	23	68.0	+18.6
12	19	165	124	57.1	-12.7	63	59.9	- 4.8	10	65.3	- 2.3
16	34	165	181	68.0	- 8.4	101	72.6	+ 8.6	10	82.1	+18.0
20	24	159	206	51.2	- 2.7	92	58.0	- 1.5	9	62.1	+ 1.5
7	36	159	176	68.0	+ 2.4	87	73.5	+ 6.5			
8	33	159	102	55.3	0.0	17	60.8	+ 7.5			
9	26	153	57	59.4	+31.6	35	61.7	+40.6			
11	30	171	153	52.2	- 6.1	69	54.4	+ 1.0			
13	34	165	91	81.6	+ 2.2	14	84.8	- 2.5			
18	26	163	114	65.8	+13.3	24	69.8	+31.5			
14	24	163	75	64.8	+ 5.7	23	68.0	- 0.5			
15	27	164	86	54.0	- 7.8	31	56.7	+ 2.0			
19	17	166	19	66.2	- 4.4						
17	27	166	19	74.8	+ 7.7						

*days before birth

**163 used for calculation of BMR for first two determinations; 166 for third determination.

Basal metabolic rates obtained during the last two months of pregnancy were correlated with fetal activity in the last two months and yielded a rank difference coefficient of +.19 ±.17. This coefficient does not represent the relationship between simultaneous measurements of fetal activity and maternal BMR; it expresses the relationship between levels of maternal metabolism and fetal activity during the last two months. Hence on this basis as well as for several other reasons, it is not strictly comparable to reported (5) coefficients of correlation between metabolism and activity of infants as measured on movable beds. Another reason for the doubtful validity of the comparison of fetal and postnatal interrelationships between metabolism and activity is the fact that one is not certain as to how to partial out the weight factor in each case. The relative degree to which surface area is effective in determining metabolism in each case is an unknown proposition. That is, the degree to which the fetus (aside from the placenta and hypertrophied uterus) may alter the mother's surface area is hardly comparable to the absolute surface area of the infant.

A third reason for the invalidity of such a comparison is the fact that, in the case of fetal activity, we are dealing with the mother's report and not with an absolute quantity. For this reason, it seemed more logical to determine the difference in basal metabolism between two points in pregnancy and calculate this difference as an increment of age. The rank difference correlation between such an increment over at least one month in maternal metabolism (the increment from the earliest to the latest BMR, excluding case 9 who had but a 22 day interval between tests) and fetal activity, for sixteen cases was +.60 ±.11. This is a fairly large coefficient, and quite reliable. Its interpretation is difficult, however.

One explanation of this relationship between maternal BMR and fetal activity in the last two months might be that there was considerable probability that the fetus who had a relatively high level of activity during the last month was also more active during the eight minute period during which the BMR determination was made. In that case the increase in maternal BMR might be attributed to some extent to the fetal movement themselves. However, simultaneous measurements of the two phenomena were not made, and it would be more parsimonious to disregard such an interpretation. Actually the movements noticed by the mother probably express but a very small part of the activity of tissue responsible for oxygen exchange, and even of the total activity of the fetus.

A second interpretation of the correlation of +.60 between fetal activity and change in maternal BMR is to regard the heightened metabolism of the whole mother-child relationship. As the mother's processes are more greatly accelerated, so are those of the parasite. This situation of accelerated metabolism in a growing system may indicate a rapidity of growth itself, perhaps largely of the fetus. Our criterion of growth in this case would not be growth of mass, as indicated by mother's weight gain (since this already is partialled out) or by weight of the child. Birth weight was seen to correlate with fetal activity only +.26 ±.16. The accelerated growth suggested in this case would be a more physiological growth,--a growth of metabolism itself, and, as an expression of this metabolism, of skeletal activity.

If this interpretation is a valid one, then the metabolising system during pregnancy should be regarded as a unit. Just as we would not ask what part of the mother's BMR was caused by her heart beat, so we would not wonder what part was due to the fetus bodily activity. The mother who manifested a heightened BMR might consume more oxygen at a given moment because of any one of a number of processes. Of these processes, skeletal activity of the fetus might form only a small part. Consequently, we might not expect a fetal movement to register as so much increase in oxygen consumption[3]; it might form part of the general acceleration of metabolism. On the other hand, this acceleration of metabolism during pregnancy might be accounted for at any one point by factors entirely apart from fetal movements as they are noticed by the mother.

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[3] The only experimental evidence we could find on this point was on the basis of personal communication from Dr. Grace McLeod. Three pregnant subjects indicated fetal movement during respiratory basal metabolism determinations by pressing the thumb and forefinger together, the two phenomena recording simultaneously on a kymograph. She says that "with two of our subjects (we) saw no consistent effect at all. A few times we thought we saw an increased oxygen consumption in a test period following one in which there had been considerable fetal movement, but on the other hand, there were many periods following periods of fetal activity in which we saw no change whatever, and in no case was the change so great as to be at all significant in comparison with the usual variations from period to period."

EFFECTS OF AGE ON ACTIVITY OF THE FETUS

Figure 1 presents graphically fetal activity for all individuals. No entirely consistent trend is apparent. It is seen, however, that the curves tend to originate at or later than the fourth to the fifth month, to rise to their highest point at about the eighth to the ninth month, and, in several cases at least, to drop off from this point to the end of pregnancy. The point at which fetal movement is first noticed by the mother is shown in some of these graphs; the data here are consistent with the usual obstetrical finding that quickening is noticed at the fourth to fifth month. It is also held generally by obstetricians that the fetus is less active just before delivery than during the preceding weeks. We cannot interpret the tendency for this drop in activity to be a consistent one applying to all our cases. If it exists as a real phenomenon, it might be explained in any one of at least three ways. Increasing head pressure might serve to inhibit bodily activity of the fetus. Again, the fetus' relative size in the last months of uterine life may actually alter the amount of movement in that there is less spatial capability of movement, or movements thus restricted may occur as frequently but be less in amplitude and so less stimulating to the mother. The third possibility is that concomitantly with the last stages of preparation for delivery uterine sensitivity itself may be altered so as to increase the mother's threshold.

Correlations between ranks of various fetuses at different months of uterine life are presented in Table 4. It is seen that these coefficients tend to range from +.56 to +.88 indicating considerable consistency in placement with respect to the group at various points.

TABLE 4

INTERCORRELATION BETWEEN RANKS IN FETAL ACTIVITY SCORES AT VARIOUS MONTHS DURING PREGNANCY. CORRELATED RANK DIFFERFNCE COEFFICIENTS

		FETAL ACTIVITY				
		LUNAR MONTH				
		6	7	8	9	10
	r		+.62 ±.18	+.74 ±.13	+.74 ±.13	+.73 ±.14
6	N		6	6	6	6
	r			+.84 ±.07	+.88 ±.05	+.68 ±.13
7	N			9	9	9
	r				+.56 ±.15	+.65 ±.12
8	N				13	11
	r					+.71 ±.09
9	N					15
	r					
10.	N					
	r	.78 ±.11	+.78 ±.09	+.76 ±.08	+.88 ±.04	+.95 ±.02
9 & 10	N	6		13	15	17

As may be inferred from the age data thus far presented, there seems to be no obvious tendency for activity to increase to any extent after about the seventh month. A correlation between activity within the last two months of fetal life and the mean age at which these records were obtained calculated on the basis of days since last menstruation yielded a rank difference coefficient for eighteen[4] cases of +.207 ±.19.

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[4] For three of the total group of seventeen subjects upon whom this report is based data was lacking; however, four new subjects were added to give a total group of eighteen. Thus, this is a group comparable to but not identical with the group used in the remainder of the study.

RELATIONSHIP BETWEEN FETAL HEART RATE AND FETAL ACTIVITY

Heart rate records for all fetuses were taken periodically during pregnancy. The mean heart rate represents the level of heart rate for a relatively long period, just as the mean activity for a number of records represents a level of activity. The rank difference coefficient for mean heart rate during the last two months and mean percentage time active for the same period, for the 17 subjects was -.22 ±.17, suggesting that there is no significant relationship.

It is well known that normally activity increases the heart rate. The failure to find a high positive correlation between fetal heart rate and activity measures here reported means only that in this group at least, the characteristically most active individuals were not necessarily those with the highest average heart rate. Our heart rate records are not taken in such a way as to afford the best correlation with activity. A simultaneous record of activity and heart rate is at present impossible under standard conditions. Until such records can be obtained it will be difficult to study this relationship critically.

OTHER RELATIONSHIPS

Rank difference coefficients between body length and body weight at birth with mean activity scores during the last two months of fetal life for sixteen subjects yielded coefficients of +.31 ±.14, and +.26 ±.16 respectively, indicating no relationship. Irwin (3) obtained coefficients with stabilimeter measurements of bodily motility of 73 newborn infants .06 ±.08 for birth weight and .02 ±.08 for weight at the time of experiment. For crown-heel length, his coefficient with motility was .030 ±.08. Motility correlated .20 ±.08 with body surface calculated according to the Lissauer formula; using the Du Bois and Howland formulae he obtained coefficients of .17 ±.08 and .14 ±.08 respectively. Comparing these with our coefficients for fetal activity it is clear that the lack of relationship between activity and physical proportions found for fetuses is in keeping at least with these data for newborn infants.

DISCUSSION AND SUMMARY

From the foregoing material it is apparent that many more problems are raised than settled by these studies of fetal activity. A list of certain questions we hope to approach as sequel to this study might be arranged as follows:

(1) What is the error of the mother's report? Do differences between mothers account for much of the differences between their reports of fetal activity?

(2) Would a concentration of time-sampling during the first weeks of fetal movement clarify our understanding of the developmental curve for fetal activity?

(3) How much does maternal posture affect the activity of the fetus, or the mother's sensitivity to fetal movement? What is the effect of fatigue, of emotional excitement?

(4) Would a simultaneous measurement of maternal metabolic rate and fetal activity clarify the relationship between general levels of these phenomena, as here reported? In similar manner, can a readaption of time-sampling and other technical factors clarify the relationship between fetal heart rate and activity?

This first analysis of fetal activity as reported by the mother has a number of technical limitations, involving the reliability of mother's report. It fails to show significant differences in activity thus reported which may be due to sex, para, age, and maternal activity. Although differences are not statistically significant, it is possible that there is a peak of activity during the eighth and ninth lunar months, with a dropping off at the tenth month. As may have been anticipated from the evidence with newborn infants, there was no evidence of diurnal or other rhythm in this reported activity.

When fetal activity level during the last two months was correlated with the mother's basal metabolic rate sampled during the same period a coefficient of .19 ±.17 was obtained. However, the correlation, not with absolute basal metabolic rate but with the increase in metabolic rate over measurements taken 52 to 197 days earlier, was .60 ±.11. This coefficient does not in any way indicate that fetal movements as single units of any sort account for the rise in metabolic rate, but suggests that both BMR and fetal activity measures are indicators of heightened metabolism of the mother-child unit.

We may conclude from this material that the method of measuring fetal activity simply by sampling the mother's report over relatively long periods is a technique of much potentiality for studying normal behavior at this little-understood period. The reliability of the method deserves further study, but it is possible that it may be more sensitive, and it is obviously more practicable than is the use of mechanical devices so far described. The report in this series which follows the present one will suggest that the method possesses a certain degree of validity, as evidenced by the possible correlation with a criterion of postnatal behavior.

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STUDIES IN FETAL BEHAVIOR: III. CAN PERFORMANCE ON TEST ITEMS AT SIX MONTHS POSTNATALLY BE PREDICTED ON THE BASIS OF FETAL ACTIVITY?[1]

T. W. RICHARDS AND HELEN NEWBERY[2]

How early in life do individual differences occur, and how prognostic are they of later differences in behavior? Aside from such studies as those of Muhlenbein (11), Bayley (1), and others dealing with the correlation between scores on baby tests at various age levels, little is known of such prediction. Measures of infant activity by means of the stabilimeter, and of specific responses of newborn infants have done little to establish criteria of individual differences at this earliest postnatal level. Stabilimeter measurements should very easily serve as individual scores, but almost no interest has been shown in treating them as such. And what of the fetal period? Will any demonstrable differences in activity during intrauterine life be indicative of later variation?

The techniques available for the study of fetal behavior are so crude and indirect that concern with the relationship between activity in fetal life and postnatal development would normally be postponed until a great deal of preliminary work has been done. However, in the course of such preliminary work progressing slowly with the addition of six or eight subjects per year, it was observed that the infant which had been most active as a fetus, had also shown certain motor performances earlier than most of the other children in the group, and that individuals least active as fetuses had in some cases been slow in acquiring motor skills postnatally. This observation suggested that even before more refined techniques for the study of fetal behavior could be worked out, and more detailed studies of early postnatal performance made, the evidence at hand concerning the relative activity of a group of fetuses and the data on postnatal development should indicate what the results of a more thorough study might be, and what avenues of attack would be most profitable.

A previous paper in this series (15) described the technique whereby polygraph records of fetal activity were obtained by having the mother report fetal movement as she noticed it, over a five or six hour period at one or two week intervals throughout the last half of pregnancy. The records were scored in terms of mean number of minutes active per ten minute period. This index constitutes the "score" for fetal activity. In order to hold age relatively constant, the scores used for comparative purposes are averages of records obtained only in the last two months of pregnancy.

Of the information available concerning postnatal behavior, the most comprehensive and statistically treatable was the data concerning performance on Gesell Schedules.' To date twelve of the infants whose activity in fetal life was studied have taken the six-months Gesell Schedule within four days of their six-month birthday. Comparing this group of twelve children at six months with a larger group of seventy-seven on the basis of number of the forty-six Gesell items passed, the results given in Table 1 were obtained. The smaller group is seen to have a lower mean and smaller variability than the larger group. These differences are not statistically significant, however.

Six members of the smaller group have taken the twelve months Gesell items within four days of their birthdays. The relationship between prenatal and postnatal performance is calculated only for these small groups.

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[1] The idea of measuring fetal behavior in the hope that it might be shown predictive of later development, both psychological and physical, was originally advanced as a research interest by Mr. Fels. His interest in this program has been greatly appreciated by the authors.

[2] From Samuel S. Fels Research Institute, Antioch College, Yellow-Springs, Ohio.

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TABLE 1

Group	A	B
No. of Cases	77	12
Maximum Score	46	39
Minimum Score	6	11
Mean Score	28.2	23.9
Standard Deviation	8.7	7.9

CORRELATIONS WITH THE GESELL SCHEDULE AT SIX MONTHS

Rank difference coefficients between activity scores[3] and performance on the Gesell Schedule[4] at six months postnatally were made by using the total score as described by Nelson and Richards (12). These coefficients are given in Table 2.

TABLE 2

Month	N	r
Seventh	6	.84 ±.08
Eighth	9	.65 ±.13
Ninth	11	.72 ±.10
Tenth	12	.54 ±.14
Ninth and Tenth	12	.71 ±.10

In a correlation such as that between fetal activity and performance at six months postnatally, actual chronological age is of obvious importance. Three-fifths of the six-months-old child's life is spent in the fetal period and the control of age to the extent only of the postnatal period could allow much room for error in correlations in which age may be presumed to operate. Of the group of cases for whom both activity and Gesell scores were available, only ten had accurate records of date of last menstruation. By partialling out age the correlation between activity and Gesell performance was changed from .659 to .064, but this was on the basis of only ten cases. It was decided to use maximum groups for each of the zero order coefficients, in an effort to determine indirectly what the influence of age on such a relationship might be for larger groups. The groups used in this analysis are shown in Table 3.

TABLE 3

SIGNIFICANT DATA RELATIVE TO GROUPS USED IN CERTAIN CORRELATIONS BETWEEN AGE, GESELL SCORES AND FETAL ACTIVITY

	Age-activity	Age-Gesell	Activity-Gesell
Number cases	18	72	13
(Age in days	248.7	460.2	
Means(Activities	3.17		3.36
(Gesell Score		29.2	23.2
(Age in days	10.0	11.2	
Sigmas(Activity	1.12		1.16
(Gesell Score		7.9	8.1
Coefficient (r_p)	.207	.294*	.663

*Pearson

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[3] The terms "activity" or "minutes active" will hereafter be used to indicate activity as reported by the mother.

[4] The authors are indebted to Dr. Virginia Nelson for Gesell material at six months and twelve months.

From Table 3 it is seen that the groups are not entirely comparable in terms of mean and sigma; differences in activity are slight, but the smaller group is slightly inferior to the larger in Gesell score (critical ratio of 2).

Correlation between fetal activity and Gesell performance partialling out age when these groups were used lowered the coefficient from .663 to .644.

From these analyses we can infer, we believe, that the error introduced by using birth rather than menstrual age in controlling the age factor is not a serious one when correlating fetal activity with Gesell performance at six months. Certainly the coefficient is not raised spuriously by introducing this error.

To return to the original correlation between fetal activity and Gesell performance, it is seen that none of these coefficients is high. However, although they are based on few cases, they are consistently positive, and large enough to be reliable. The relationships among the fetal age levels and the six-months Gesell score were almost without exception as high as were the interrelationships among fetal age levels, described in the previous report (15). In other words, there would seem to be a factor or group of factors common throughout fetal life, which are still present at six months of age. The rank difference correlation between fetal activity and Gesell scores at twelve months was .62 ±.18, suggesting that this common factor (or factors) does not drop out even after six months.

Another analysis of these relationships was made in the following way. The distribution of the twelve subjects according to activity in the last two months was divided into tertiles. Median scores on the Gesell Schedule at six months were calculated for each of these groups. The results are given in Table 4. It will be seen that the children in the highest tertile of fetal activity obtained the highest median Gesell score at six months, and those in the lowest tertile obtained the lowest median six months score. Because of the sparsity of cases we could not determine the significance of these differences. A suggestion of their significance is rendered by comparing the differences themselves with the sigma of total Gesell scores for these twelve children and for a larger group of seventy-seven children (12). These sigmas are 7.9 and 8.7 respectively. The differences are 13 between lowest and highest fetal tertiles, 10 between highest and middle, and 3 between middle and lowest. Thus, the lower tertiles differ from the upper tertiles by more than one sigma of the total distribution of scores.

TABLE 4

FETAL ACTIVITY SCORES

	576-402	377-290	227-174
Total Score			
Median	31	21	18
Maximum	39	35	21
Minimum	20	18	13

All of these facts bear out the suggestion of the correlation material that some factor which is operative in producing a high score for percentage of time active in fetal life, is also operative in performance on the Gesell items at six months postnatally.

The data were treated in still another way. Performance on Gesell items at six months was analysed in terms of fetal activity. This was done by comparing for each item the median fetal activity scores of those who passed and those who failed. The differences between medians of passing and failing groups are given in Table 5.

TABLE 5

Gesell Item	Median Fetal Activity Score		Difference
	Passing	Failing	
Creeps or hitches	5.76*	3.31	2.45
Drops object into cup	5.76*	3.31	2.45
Secures pellet	5.76*	3.31	2.45
Inhibits head and one hand	4.17	2.18	1.99
Sits alone	4.88	2.90	1.98
Picks up cube	3.77	1.84	1.93
Sits with slight support	4.02	2.09	1.93
Pats table	3.90	2.06	1.84
Manipulates one hand	4.02	2.27	1.75
Music: stops crying	4.02	2.27	1.75
Looks for fallen object	4.17	2.58	1.59
Crumples paper	3.40	1.84*	1.56
Dangling ring: clasps	3.40	1.84	1.56
Dangling ring: closes in	3.40	1.84*	1.56
Expresses recognition	3.40	1.84*	1.56
Prefers one hand	4.45	3.10	1.35
Conscious of fallen object	3.90	2.58	1.32
Music: laughs	3.90	2.58	1.32
Takes bottle in and out mouth	3.58	2.27	1.31
Conscious of strangers	3.40	2.09	1.31
Plays with objects	3.40	2.09*	1.31
Turns head to bell	3.40	2.27*	1.13
Reacts to mirror image	3.40	2.27	1.13
Splashes in tub	3.40	2.27	1.13
Exploratory manipulations	4.02	2.90	1.12
Reaches directly for spoon	3.00	2.79	1.11
Blinks at pencil	3.58	2.58	1.00
Paper: purposeful reaction	4.33	3.36	.97
Dangling ring: above head	3.90	3.10	.80
Makes stepping movements	3.90	3.10	.80
Regards pellet	3.90	3.10	.80
Throws objects to floor	3.90	3.10	.80
Bangs spoon - reaching	3.58	3.10	.48
Dangling ring: persistent	3.77	3.31	.46
Drops one cube for third	3.77	3.31	.46
Holds two cubes	3.36	3.14	.22
Rolls back to stomach	3.40	3.31	.09
Says "mamma", "dada"	2.88	3.36	-.48
Secures cube	2.27	3.40	-1.13
Lifts inverted cup	3.31	4.88*	-1.57
Mean			1.27
Sigma			.82

*Items passed or failed by only one subject.

It is difficult from this ranking to make any psychological explanation of what abilities are most closely related to the factors involved in fetal activity. The order in which the items appear to be predicted from fetal activity scores seems to bear no relationship to factor loadings of Gesell items as reported in another study (14). If the arrangement of items in this order is borne out in subsequent correlation using larger groups, it is planned to analyse it in detail, with the hope that it may yield some psychological significance. At present there is no explanation for the varied nature of the items which are best (or most poorly) predicted by fetal activity scores.

Due to the fact that our total group of fetuses was a small one, no attempt was made to determine critical ratios for the differences above. It will be seen that of the forty, only three are negative. Comparison of the actual size of the differences with the semi-interquartile range for the total group of fetuses on activity (0.995) shows that twenty-seven of the forty differences are greater than this measure of dispersion in the positive direction, while two surpass it in the negative direction. Three positive differences are more than twice the semi-interquartile range.

It may also be of significance to note the distribution of fetal activity scores on items which were passed or failed by only one subject. There were nine such items. In the three cases in which the item was failed by all subjects but one, the one passing was the subject with the highest fetal activity score. In five of the six cases in which all but one subject passed, the one failing was in the lowest tertile for fetal activity. These observations add further support to the suggestion that ability to pass Gesell items may be predicted in part from fetal activity.

DISCUSSION AND SUMMARY

The evidence presented in this paper is based on observations of only twelve cases. Several statistical approaches to the material obtained agreed very closely in suggesting that for this group there was a positive relationship between fetal activity as reported by the mother and performance on the Gesell items at six months. Rank difference coefficients in all cases were four times their probable errors. No spurious age factor was found to account for these relationships. In terms of prediction, these coefficients would indicate (according to r^2) that from thirty to seventy per cent of the variance at six months is measured by the activity records during fetal life.

At least four explanations for this correlation might be suggested. The first two of these refer to the fact that our criterion of fetal activity is based upon the mother's report of activity rather than on fetal activity actually measured. Thus, mothers who tend to report more activity during fetal life may be the mothers who endow their offspring with greater ability at six months postnatally either (1) genetically or (2) by surrounding the child with environmental factors conducive to mental development. Each of these explanations is worthy of consideration. Evidence from the literature would suggest that mental ability during the early years may be related to a broad environmental estimate such as socio-economic status or parental intelligence (1, 11), but to the authors' knowledge this has not been demonstrated for ability at six months. Indeed, Bayley's (1) work would indicate that during the early months such influence is not effective, appearing effective only later than eighteen months. How much factors such as personality traits of the mother, a tendency to notice or to report movement, etc., may contribute to such possible relationship we do not know.

The third and fourth explanations of the relationship between fetal activity and performance at six months assume that the fetal scores indicate actual variability among fetuses. The relationship may be due (3) to the facilitation of six months ability by the very exercise of function itself; the activity demonstrated by some fetuses, whatever its genesis may be, actually improves function so that the child's performance later on is facilitated. That is, the child's behavior is modified by exercise. Frequency of activity, which essentially is most likely what we are measuring at the fetal level, would seem to be analogous to an exercise function of some sort.

Regarding this explanation certain considerations are important. The activity measured during the fetal period would not seem to be in any way the same function as that measured at six months. In one instance, we are dealing with the amount of time during which activity of any sort is present; in the second instance we are dealing with responses which seem highly specific by comparison. If a training effect explains the correlation found, it is necessary to assume that this effect is in the nature of general facilitation of behavior--a sort of increase in the "g factor", due to activity in fetal life. Again the evidence of Wenger (10), Kantrow (0), and others for conditioning during the newborn period (9) gives little comfort to the thought that learning is possible during this early stage of life. Conditioning has been reported for newborn infants, but not unequivocally and as a normal function for most children. When we consider fetal conditioning, positive evidence is even more tenuous; the few experimental studies (13, 16) have not indicated that the fetus is conditionable.

The fourth explanation of the correlation between fetal activity and infant performance at six months is that the amount of time a fetus is active is a criterion, during fetal life, of the developmental pattern or patterns of behavior responsible for rather specialized performances at six months postnatally.

A quotation from Coghill (3) is pertinent in this connection:

> "From the facts related. . . . . it is obvious that there are two processes that are operating simultaneously in the development of behavior. The one is expansion of the total pattern as a perfectly integrated unit; the other is the individuation of partial systems which eventually acquire more or less discreteness. In Amblystoma the total pattern first extends through the trunk and tail. As this pattern enlarges, the parts involved are always perfectly integrated. This totally integrated pattern then extends into the gills, next into the fore limbs and finally into the hind limbs. But as the totally integrated pattern expands through the organism, its parts, one after another, in the same order as they were invaded by the total pattern, begin to acquire a measure of individuality of their own; first the gills, the fore limbs and finally the hind limbs. This means that local reflexes emerge as, in the language of 'Gestalt', a 'quality upon a ground'; that is to say, they emerge as a special feature within a more diffuse but dominant mechanism of integration of the whole organism. They cannot be regarded as simply the action of a chain of neurones, excepting as every link of the chain is conceived to be welded into the organism as a whole." (p. 88-89).

The fetal "activity" we have measured and discussed in this paper, since it represents amount of movement in time rather than type or quality of response, may be considered only with difficulty as expressing "pattern" of behavior. However, just as metabolic rate or muscular tension may form part of a pattern, so may fetal movement expressed in this way.

Assuming that our measure of fetal activity is a sort of "test", its relationship to the postnatal test is suggested by a recently published discussion quoted from the Manual of Child Psychology by Stoddard and Wellman (17).

> "It is necessary to avoid the error of believing that things contributing to the same general function must themselves be alike or look alike. A task may be performed with or without verbalization, and the two acts appear grossly unlike, yet they may make essentially the same contribution to a pattern of intelligence. For example, the placing of one cube on top of the other by a child may contribute to the measurement of intelligence as adequately as the definition of pity fifteen years later.
>
> "In measuring intelligence, we are getting at not only ingredients of the whole pattern, but at indicators, surrogates and prognosticators. We need not bother at all about the external appearance of our tests if they are shown (a) to be, or to be related to, (b) to be surrogates of, or (c) to predict the likelihood of, intelligent behavior as defined. If the goal is not so much to measure intelligence as to analyse the whole behavior pattern of the child, we are of course justified in focusing our attention upon any practical aspect of development or behavior, such as motor skills, speech or ability in spatial relations."(p. 45)

In our fetal studies we may have evidence (somewhat humble, to be sure) that the specialized behavior observable at six months actually emerges from a pattern of which simple frequency of response is diagnostic during the fetal period.

The fact should be mentioned that reports of Minkowski (10), Bolaffio and Artom (2), and others concerning reflex behavior of fetuses removed from the uterus indicate that specific movements may occur as early as the third month of fetal life. Thus, it is possible that our measurements of activity during the last months of fetal life, measure at that late date very little of the mass activity characteristic of Coghill's precursor to individuated, specialized responses. On the other hand, Irwin (5, 6, 7) has been vigorous in his description of "mass activity" as the most characteristic and dominant form of behavior even in newborn infants.

A final consideration is the problem of mental organization during these early months of life. A solitary attempt to find a general factor or any other factors which might account for the relation of various forms of reflex behavior in newborn infants was made by Furfey, Bonham, and Sargent (4). They failed to find correlation between such phenomena at that level and concluded that no general or other factor was evidenced. In the light of newer techniques of analysis it would be interesting to know whether the single tests used by these investigators were sufficiently reliable to measure the variance due to common factors, should these be present. A recent attempt to determine primary factors in Gesell performance at six months (14) indicated that there was at least one factor and perhaps three factors present at this level.

We should conclude this list of explanations by stating that we are open to conviction regarding any one of these possibilities, or regarding any other which may emerge. Actually, our correlation is open to much question, due to sampling error and it may disappear with more adequate sampling. At present it stands out as a finding quite unanticipated and certainly worthy of careful validation, explanation, and interpretation.

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ANATOMIC LAG[1]

WILSON D. WALLIS

By anatomic lag we refer to the tendency of an anthropometric dimension to lag, in relative value, upon another with which it is correlated. Thus, when head length as dependent variable is plotted against head width as independent variable, rate of increase in head length is less than rate of increase in head width; conversely, when head width as dependent variable is plotted against head length as independent variable, head width does not increase at the same rate as head length, but lags on head length. A similar phenomenon is observed in the case of many other paired dimensions of head or body, in most cases, it appears, with differential rates of lag. In some cases, however, the dependent variable accelerates upon the independent variable against which it is plotted, that is, increases at a faster rate than does the independent variable.

Relative rates of increase, i.e., of lag or acceleration, cannot be detected in the usual coefficient of correlation.

Examples of changes in proportion with increase in dimension are shown in the accompanying figures. Basic dimensions are reduced to the same absolute scale. The compared predicted dimension is expressed as a percentage of the basic dimension.

The coefficient of linear correlation is not changed if to a series of paired head length and head width we add any constant unit to each item of either or both variables; though such addition would, of course, change the relative increase of the items of a given variable. Much anthropometric work is concerned with proportions, that is, with relative values of two dimensions. If index is a function of dimension, that is, if there is lag or acceleration of one dimension upon another, then dimension must be held constant when comparing proportions between two groups if we wish to know to what extent the difference in proportion is a group phenomenon as distinct from a mere biometric phenomenon. This will apply when, for example, one wishes to determine whether group differences are attributable to some other factor or factors than sheer dimension. So far as we can ascertain, this fundamental biometric problem has not been analyzed; and no account of the principle has been taken in comparative anthropometric work.

In 1901 and 1903 Pfitzner (Ztschr.f.Morphol.u.Anthropol.,3,5) showed that proportions change with dimensions in each sex; but he seems not to have appreciated the character of the change, although all of his tabulations show distinct trends of index with increase in dimension. Many correlations published in Biometrika show that when a dimension is correlated with an index of which that dimension is a component there is a significant correlation, the sign depending upon whether the x variable correlated with y is correlated with x/y or with y/x. The meaning of these correlations, however, is nowhere indicated. In the same journal, some thirty years ago, Professor Raymond Pearl pointed out the lag in length-width dimensions of paramecium. We have seen no other application of the principle to animals, yet the following tables suggest that anatomic lag is as typical of lower animals as of man.

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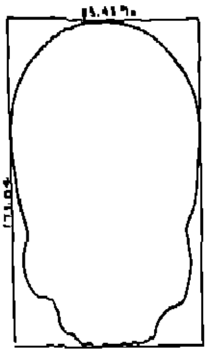
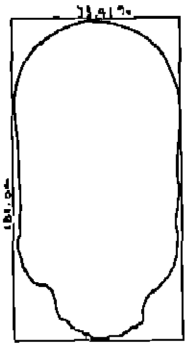


157 Peruvian, males



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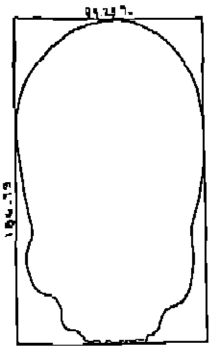
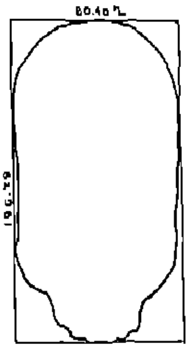


1898 German, males



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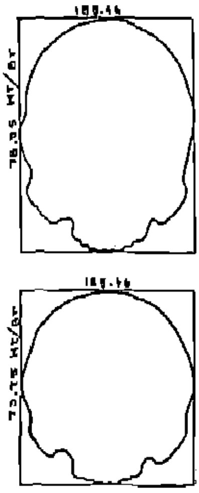
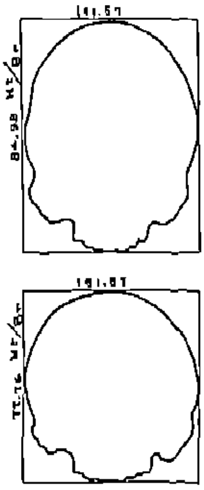
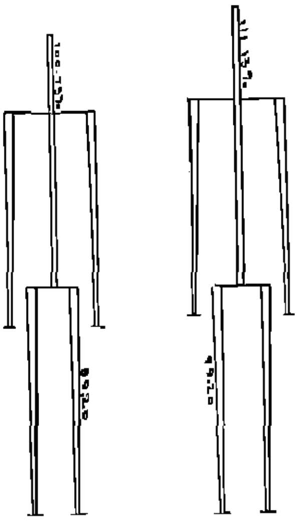


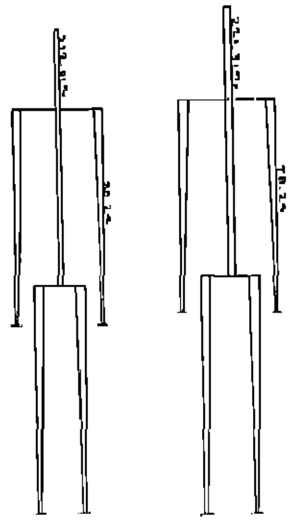
1756 German, males



220 New Guinea males



600 German, males
Stem Length Divided by Leg Length



1273 German males
Stature Divided by Arm Length

METHODS OF ANALYZING LAG

Method of analyzing lag is to some extent dependent upon character of available data. Hence we have not been able to adopt a uniform method of presenting results of analyses.

1. Lag is shown by the correlation of a dimension with an index of which that dimension is a component; that is, of x with x/y, or of y with x/y; for example, head length with cephalic (cranial) index, or head width with cephalic index.

2. When r xy is given, r of y with x/y (I) can be derived from the formula:

$$r\ YI = \frac{r\ xy - \frac{Vy}{Vx}}{\sqrt{1 - r^2 xy + (r\ xy - \frac{Vy}{Vx})^2}}$$

Testing with data in which the correlation of YI has been made directly shows that this formula gives the r of YI with close approximation in large series, that is, within .05. Many of our coefficients have been computed directly from dimension and index, and many have been computed by the last formula.

TABLE A

COEFFICIENTS OF CORRELATION BY ABOVE FORMULA AND BY DIRECT CORRELATION OF Y WITH $\frac{x}{y}$. DATA OF SCHUSTER, OXFORD UNDERGRADUATES, LIVING MALES (*BIOMETRIKA*, 8)

No.	Age	r of Stature-$\frac{\text{Leg length}}{\text{Stature}}$		Difference
		By formula	From raw data	
129	18	.42	.44	-.02
330	19	.35	.37	-.02
209	20	.39	.42	-.03
137	21	.48	.50	-.02
95	22	.40	.45	-.05

3. Lag or acceleration of dimension is indicated also in the prediction formulas r xy $\frac{Vx}{Vy}$ and r xy $\frac{Vy}{Vx}$, a modification of the usual regression formula, in which for S.D., absolute variability, V, or percentage variability, is substituted. Thus if r xy (Vx/Vy) is 1, there is no lag or acceleration of x on y. The relative regression coefficient r xy $\frac{Vy}{Vx}$ indicates percentage change in y for 1 per cent change in x. Amount of lag, therefore, is inversely as the value of r xy $\frac{Vx}{Vy}$, or of r xy $\frac{Vy}{Vx}$, the relative regression coefficients.

A value above 1 indicates percentage acceleration.

Thus: $x-\bar{x} = r\ xy\ \frac{\text{sigma } x}{\text{sigma } y}\ (y-\bar{y})$; $\frac{x-\bar{x}}{\bar{x}} = r\ xy\ \frac{\text{sigma } x}{\text{sigma } y}\ \frac{1}{\bar{x}}.\ \bar{y}\ \frac{y-\bar{y}}{\bar{y}}$;

$x-\bar{x} = r\ xy\ \frac{\text{sigma } x}{\text{sigma } y}\ .\ \frac{\bar{y}}{\bar{x}}\ \frac{y-\bar{y}}{\bar{y}}$; $x-\bar{x} = r\ xy\ \frac{Vx}{Vy}$'

Similarly, $\underline{y-\bar{y}} = r\ xy\ \frac{Vy}{Vx}$. Or, if each item of $x1\ x2$...be divided by $\bar{x}$, and each item of $y1\ y2$...be divided by $\bar{y}$, we reduce each item to a percentage of the mean, and do not change the value of the coefficient of correlation. Thus $r\ xy = r\ \frac{x}{\bar{x}}\frac{y}{\bar{y}}$ and the regression, $r\ xy\ Vx/Vy$ gives percentage change in x for 1 per cent change in y.

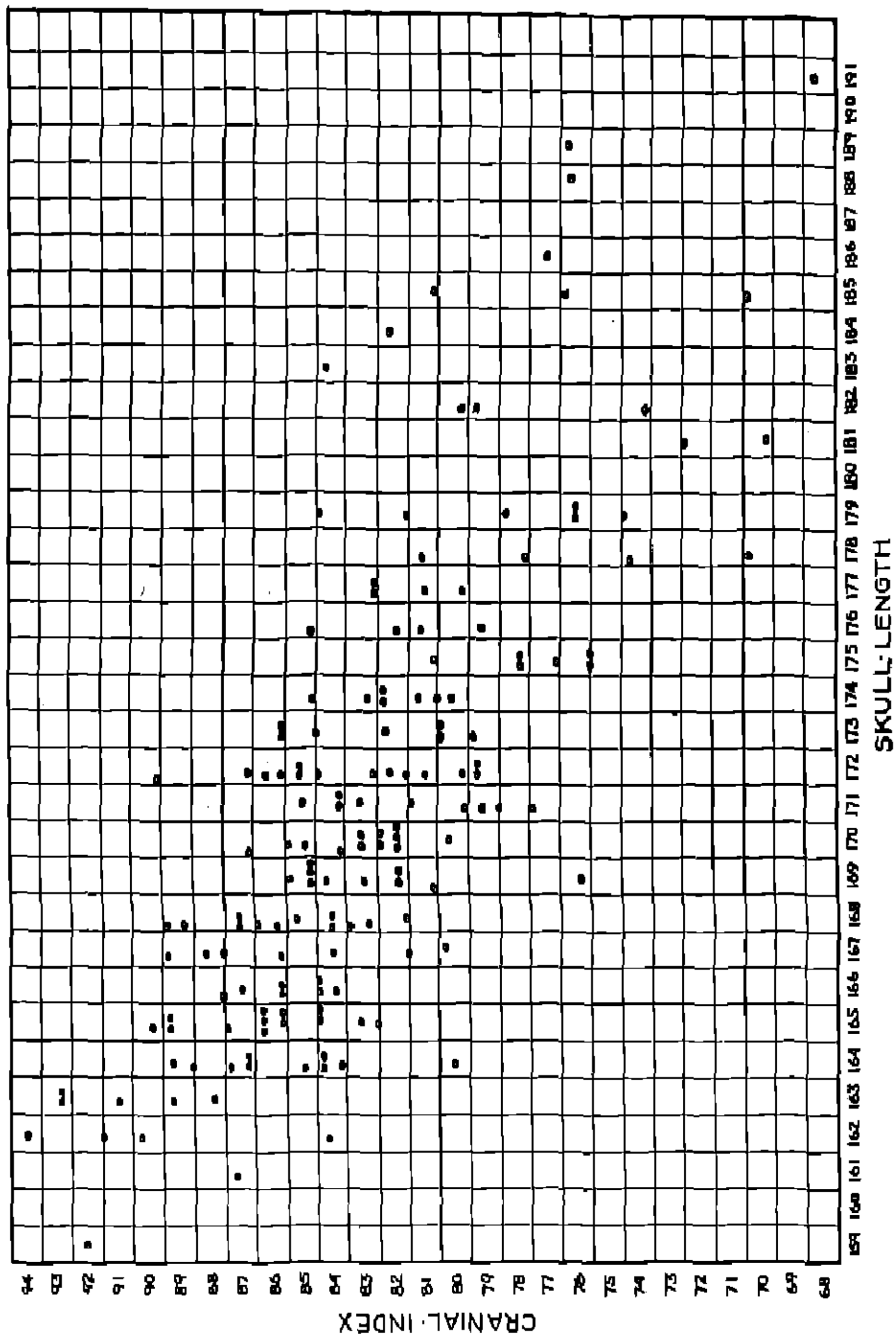
4. From series which do not permit derivation of coefficient of correlation we computed regression of index upon dimension, or conversely. The sign of regression indicates presence or absence of lag, and its value indicates degree of lag.

5. Inasmuch as the relative regression coefficient expresses rate of change of one variable against another, it is possible to compare them in an index or ratio. Thus if the relative regression coefficient of lag of head breadth on head length is .20, and of head length on head breadth is .40, the ratio is $\frac{.20}{.40}$ or .50. Such a ratio or index makes easily comparable the ratio of lags of two given variates in different series, and ratios of lag of various dimensions against a given dimension, as for example, head length against head breadth, or head height, or face breadth, or face height, and so on.

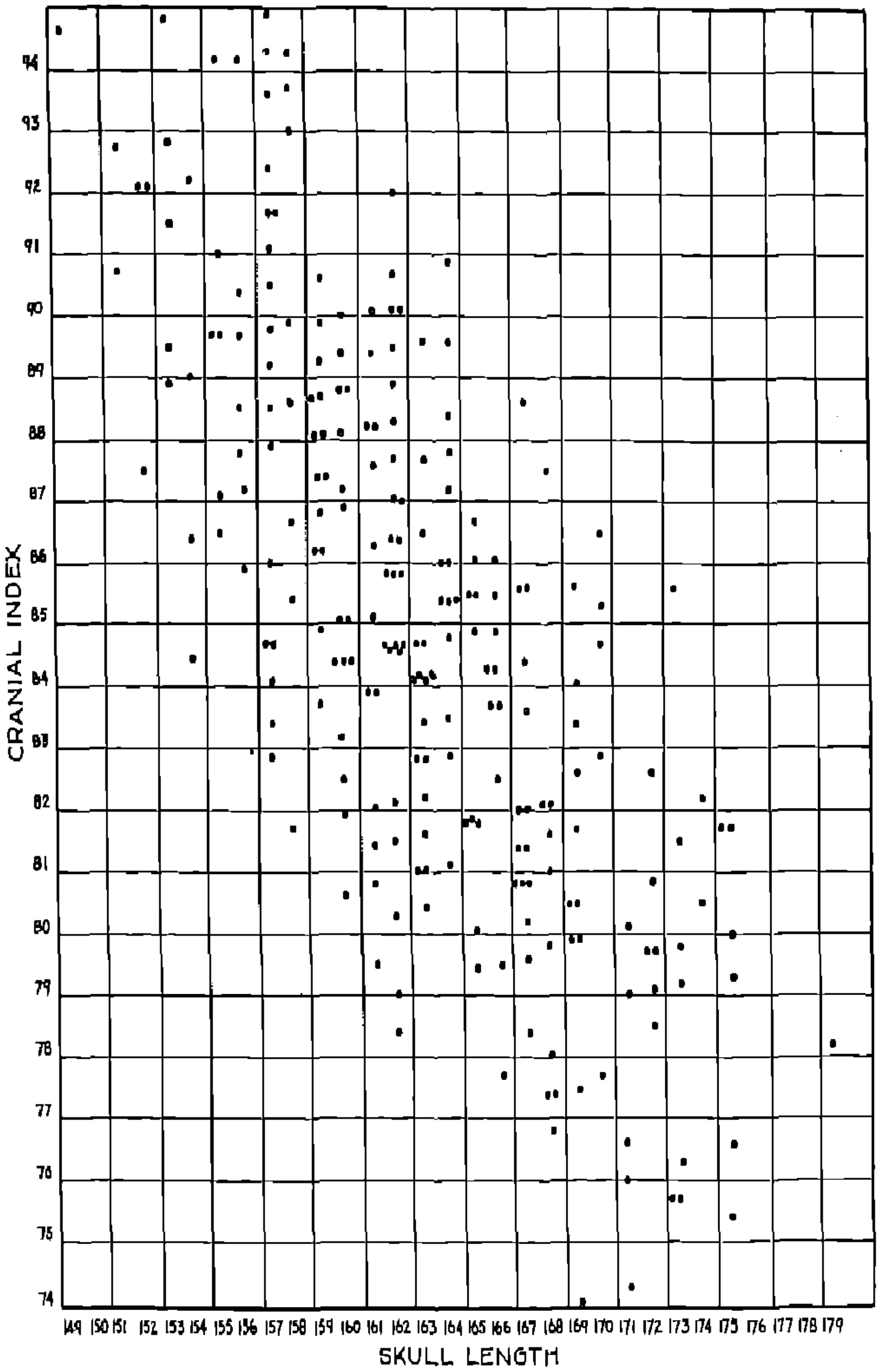
Inasmuch as ratio of lags of paired x and y expresses ratio of percentage increase in respective variables, it follows that the ratio indicates type and amount of change in the index of which x and y are components; and thus discloses the trend in these proportions prior to or during the age period analyzed. Thus if the lag of (x) head breadth on (y) head length is the same as the lag of head length on head breadth, then increase in size of head, as measured by these two dimensions, does not result in a change in breadth/length index. If, however, the ratio (lag of x/lag of y) is less than 100, increase in size of head is accompanied by a lowering of breadth/length index; whereas a ratio above 100 indicates increase in breadth/length index. It should be remembered, however, that (1) most of our data deal with end-points of growth, in adults, or with a small age range in the pre-adult period; and (2) there are age changes during adult life. The data, therefore, do not disclose whether we are (1) merely recording changes which have previously occurred and have persisted into subsequent age levels, or (2) are observing changes within an age group, or (3) both.

TESTS OF LINEARITY FOR DIMENSION AND INDEX

Inasmuch as the legitimacy of our correlation of dimension and index depends upon linearity of the variables, we tested the linearity in three series. For cranial length and cranial index presented in a scatter diagram and in a correlation table for a series of 157 Peruvian male skulls and 242 female skulls (Sankas, *Am. J. Phys. Anthropol.*, 14:309-315, 1930) the relationship is linear. A correlation table of head breadth and cephalic index in a series of 220 living natives of the North Coast of New Guinea (*Pöchs Nachlass*, Series A, II, 172-178) shows a similar linear relationship. A scatter diagram of ear length and ear index in 145 Peruvian males (Ferris, *Am. Anthropol. Assoc. Mem.*, 3:106-121, 1916) shows less marked linearity.

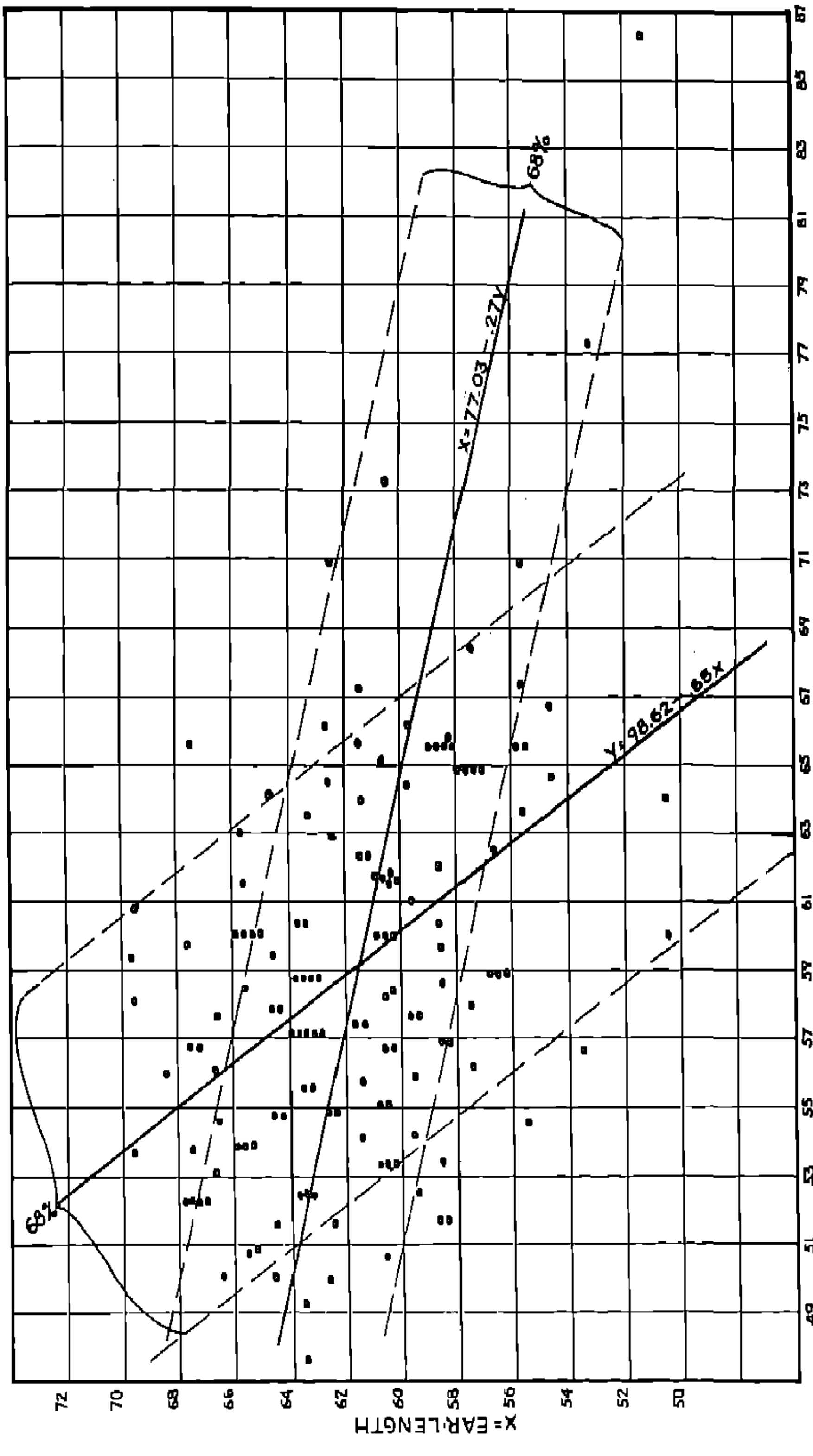


— 157 PERUVIAN MALE SKULLS —
(SANKAS, *AJPA*, 14:309, 1930)

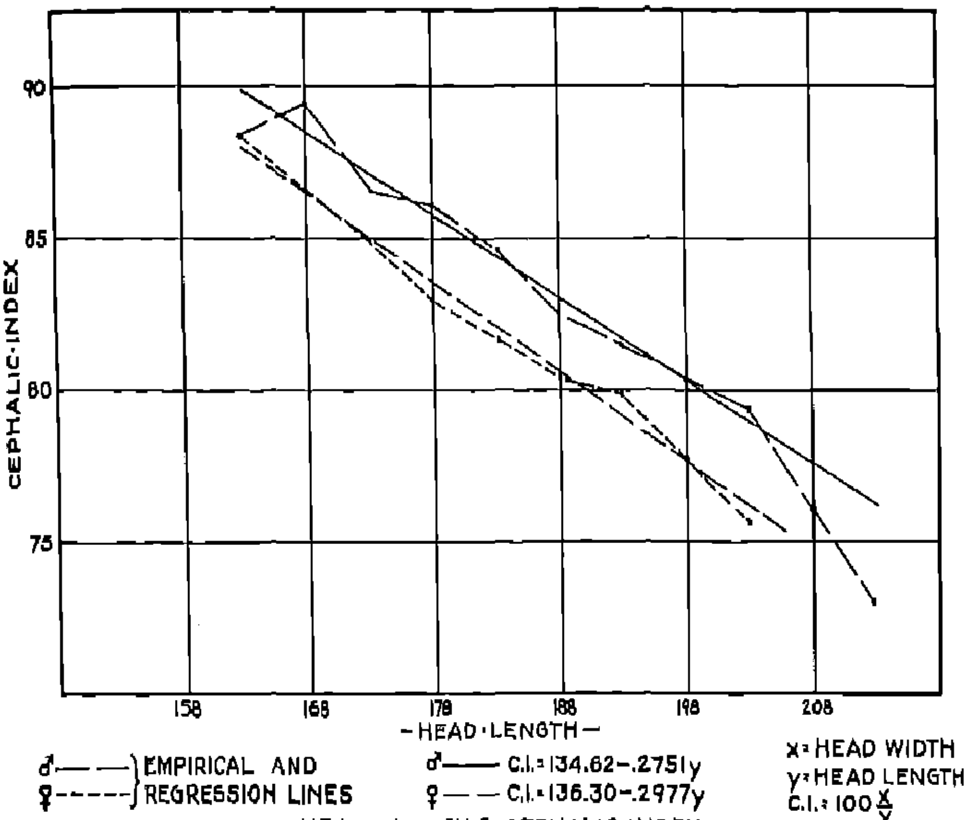


-- 242 PERUVIAN FEMALE SKULLS --

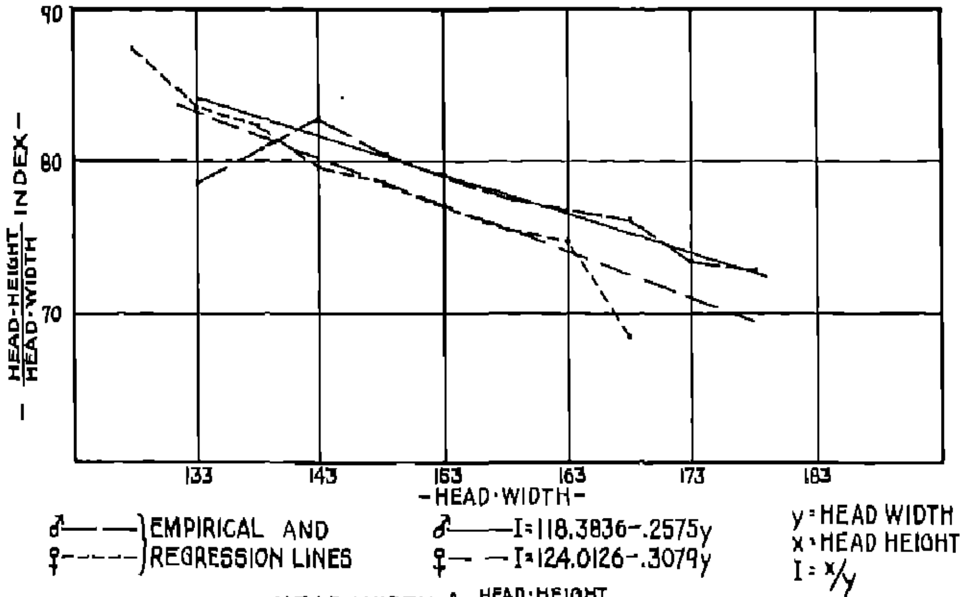
(SANKAS, *AJPA*, 14:312-15, 1930)



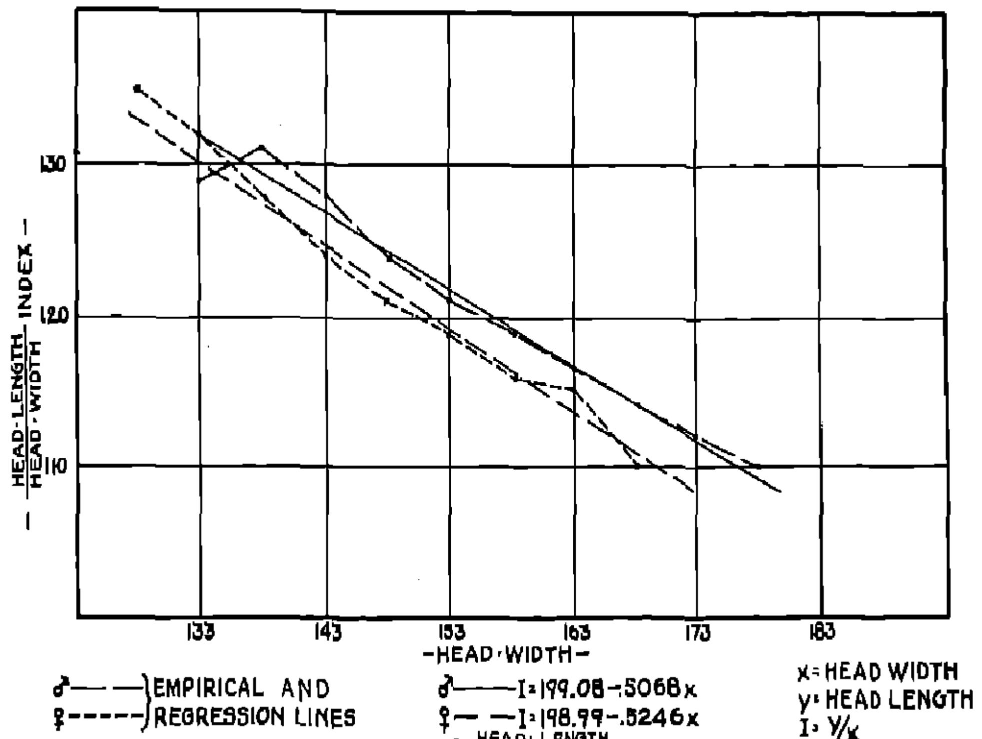
-o- RELATION·BETWEEN·EAR·LENGTH·&·EAR·INDEX, 145·PERUVIAN·MALES -o-
(FERRIS, *MAAM*, NO. 3: 106-121, 1916)



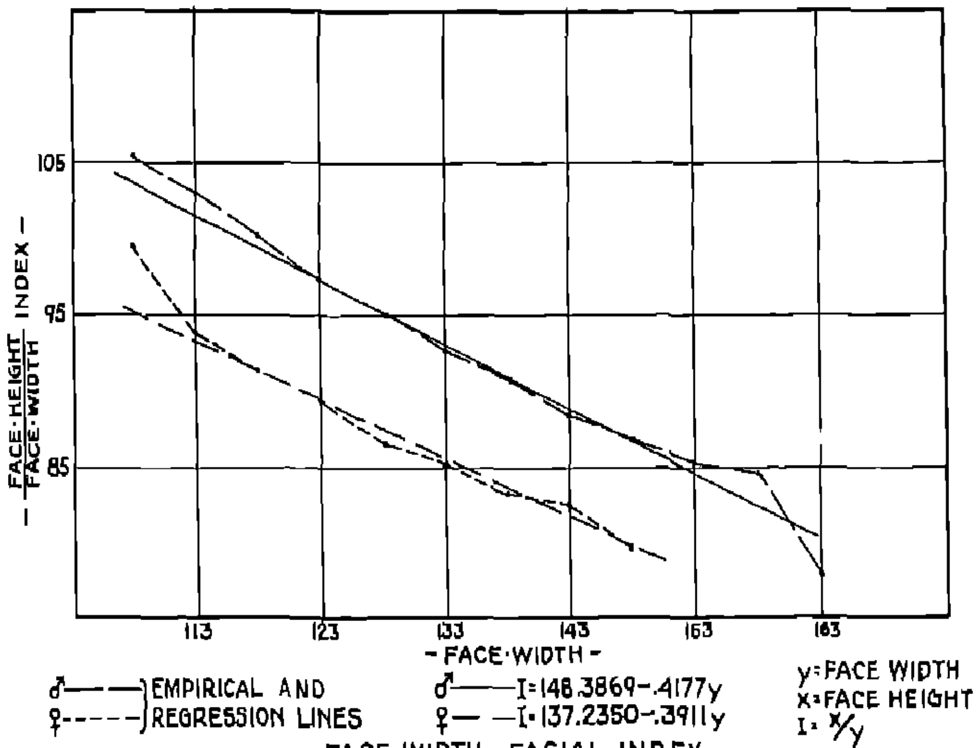
HEAD·LENGTH & CEPHALIC·INDEX
••• 1874·MALES, 1487·FEMALES, LIVING·GERMANS •••
(PFITZNER, *ZfM&A*, 5:263, 1903)



HEAD·WIDTH & $\frac{\text{HEAD·HEIGHT}}{\text{HEAD·WIDTH}}$ · INDEX·IN
∘·∘ 1735·MALES, 1395·FEMALES, LIVING·GERMANS ∘·∘
(PFITZNER, *ZfM&A*, 5:266, 1903)



HEAD·WIDTH & $\frac{\text{HEAD·LENGTH}}{\text{HEAD·WIDTH}}$ · INDEX· IN
••• 1893·MALES, 1488·FEMALES, LIVING·GERMANS •••
(PFITZNER, *ZfM&A*, 5:264, 1903)



FACE WIDTH, FACIAL INDEX,
••• 1745·MALES, 1396·FEMALES, LIVING·GERMANS •••
(PFITZNER, *ZfM&A*, 5:267, 1903)

Using Pearson's formula (Proc. Roy. Soc., 60, 489-490, 1897) for deriving the sigma of I, namely

$$\text{Sigma } I = \bar{I}\sqrt{V^2x + V^2y - 2\ r\ XY\ Vx\ Vy}$$

the relations between the r and the eta correlations of head dimensions and indices in living Germans (*Pfitzner*) *are shown in Table B.*

TABLE B

No.	Sex	r	eta	Variables correlated
1898	M	-.51	.51	Head length - $\frac{\text{Breadth}}{\text{Length}}$
1497	F	-.52	.53	" " "
1898	M	-.57	.57	Head width - $\frac{\text{Length}}{\text{Breadth}}$
1497	F	-.57	.60	" " "

Testing shows that r and eta do not differ more than would be expected by chance.

For the series of 242 female Peruvian skulls linear correlation of skull length with cranial index is -.7171. The coefficient of X eta Y is .7209. $\frac{eta^2 - r^2}{1 - r^2}$ is .0113. In a series of 57 Alsatian skulls coefficient of regression of length on cranial index is -3.66 and of cranial index on length is -2.07. Respective values by eta correlation are 4.50 and 2.27.

In a series of 28 Alsatian skulls regression of length on index is -2.10 by r and 2.53 by eta. In Table C (Pfitzner) testing shows that regressions by r and by eta do not differ more than is to be expected by chance.

TABLE C

REGRESSIONS BY r AND BY eta, LIVING GERMANS (PFITZNER)

Variables		No.	Sex	Regression XI		r - eta
X	I			r	eta	
Head Breadth -	Cephalic Index	1899	M	3.28	3.32	-.04
" "	"	1497	M	3.14	3.31	-.17
Head Length -	Cephalic Index	1898	M	-2.12	2.04	.08
"	"	1497	F	-1.96	1.99	-.03
"	"	1874	M	-1.89	1.90	-.01
"	"	1487	F	-1.91	1.92	-.01
Head Breadth -	$\frac{\text{Length}}{\text{Breadth}}$	1893	M	-3.239	3.278	-.04
"	"	1488	F	-3.009	3.041	-.03
Face Width -	Facial Index	1745	M	-3.02	3.03	-.01
"	"	1396	F	-2.59	2.64	-.05
Head Width -	$\frac{\text{Head Height}}{\text{Head Width}}$	1735	M	-1.66	1.72	-.06
"	"	1395	F	-1.81	1.86	-.05

Regressions are almost uniformly lower by r than by eta, in the above series, but in no case is the difference as great as .2. In view, then, of the close correspondence of r and eta and of the respective regressions, it seems legitimate to analyze the relationship by the shorter r method. The tables which follow give regression coefficients and, where the data permit its computation, either the coefficient of correlation of dimension with index, or relative regression coefficient, or both.

We use the designation k to signify regression coefficient. Ratio of lag is lag of x(100)/lag of. y. Inasmuch as lag is inversely proportional to the quantity r xy(Vx/Vy) or r xy(Vy/Vx), when the values are plus, and directly proportional when they are minus, interpretation of the ratio of lags must take account of the signs.

For convenience of reference we have listed paired dimensions alphabetically under the respective headings of Head and Skull, and Body Proportions, with alphabetic order under Stature, in the latter group.

LAG IN HEAD AND SKULL

TABLE 1

x, Cranial Capacity
y, Cranial Dimensions, l, $\frac{x}{y}$

Baganda Crania

y	Male N	Male r xy	Male r xl	Female N	Female r xy	Female r xl
Head Length	67	.50	-.91	123	.60	-.90
Head Breadth	67	.43	-.90	113	.57	-.87
Head Height	66	.64	-.88	114	.52	-.85
Horizontal Arc	66	.68	-.96	115	.72	-.96
Vertical Arc	67	.66	-.91	118	.60	-.92

TABLE 2

x, Face Breadth
y, Face Height, l, $\frac{x}{y}$
(Nasion-alveon height, except in case of Pecos, Nasion-menton height)

Group	Sex	N	r xy	r xy (Vx/Vy)	r xy (Vy/Vx)	Ratio of Lags
LIVING						
North Sweden	M	4795	.15	.09	.23	40
West Sweden	M	13222	.17	.11	.16	42
East Sweden	M	15497	.16	.11	.24	44
South Sweden	M	8714	.19	.12	.29	42
Cities Sweden	M	4755	.16	.10	.25	41
Total Sweden	M	47183	.18	.12	.28	42
Germans	M	1745	--	.19	.33	54
German	F	1404	--	.21		
Alsace	M	22	--	.51		
Yale	M	14	--	.46	--	
Tallhouse	M	11	--	.31	--	
SKULLS						
Pecos	M	86	.22	.21	.27	91
Pecos	F	59	.14	.17	.69	25
Pecos	M	90	.20	.16	.24	67
Pecos	F	61	.27	.14	.52	27
Egyptians	M	700	.28	.17	.46	37
Egyptians	F	400	.33	.21	.52	40
Andaman	M	12	.49	.39	.61	64
Andaman	F	12	.38	.22	.66	33
Teneriffe	M	245	.49	.50	.80	58

Group	Sex	N	bx	bl	r xl
LIVING					
Norway 18 groups	M		-.30l	-1.86n	-.74
Norway 14 groups	M		-.09l	-.25n	-.27
Peruvian Indians	M	144	-.10l	-.04n	-.07
Peruvian Indians 7 groups	M		--	.25n	-.33
Negro	M	20	-.69l	-.46n	-.56
SKULLS					
Sardinians	M	10	-.67l	-.58n	-.62
Naqada	M	77	--	--	-.47
Naqada	F	101	--	--	-.24
Egyptians	M	700	--	--	-.32
Egyptians	F	400	--	--	-.31
Sediment, Egyptian	M	36	-.155l	-.01n	-.02
Egyptian	F	29	-.02l	-.02n	-.07

x, Face Breadth
y, Facial Index

Group	Sex	N	bx	bl	r xl
SKULLS					
Batavia, Java	M	30	-.55	-.73	-.63

x, Face Breadth
y (l), Total Facial Index

LIVING					
English Ordinary Criminals	M	100	.41	.54	.46
English Lunatic Criminals	M	30	.27	.70	.48

TABLE 2A

x, Ear Length
y, Ear Width

Group	Sex	N	r xy	r xy (Vx/Vy)	r xy (Vy/Vx)	Ratio of Lags
LIVING, Means						
Germans, Balkans	M	7	.74	.84	.65	129
Lazs, Black Sea	M	15	.38	.45	.31	136
Greeks	M	13	.68	.91	.51	56
Albanians	M	11	.88	.97	.79	121
Serbs	M	11	.82	.57	.69	83
Jews Balkans	M	8	.71	.21	.39	87
Gypsies, Balkans	M	8	.84	.76	.92	83
Osmanli Turks	M	30	.38	.24	.55	67
Bulgarians	M	20	.44	.28	.69	41
Balkans	M	14	.33	.37	.27	137
Roumanians	M	18	.46	.61	.35	174
Tatars	M	22	.41	.32	.54	59
Eskimo	M	7	.52	.55	.49	112

TABLE 3

x, Face Breadth
y, Bijugal Diameter

Group	Sex	N	r xy	r xy (Vx/Vy)	r xy (Vy/Vx)	Ratio in Lags
LIVING, Means						
Serbs	M	11	.86	.93	.80	116

x, Face Breadth
y, Total Face Length

LIVING, Means						
Chinese, Turkestan Pamirs	M	25	.27	.68	.11	618

x, Face Breadth
y, Ophryon-Menton

LIVING, Means						
Balkans	M	13	.74	.15	.72	104
Osmanli Turks	M	20	.58	.13	.64	38
Tatars	M	22	.57	.28	1.18	24
Greeks	M	13	.65	.40	1.09	37
Jews, Balkans	M	8	.55	.51	.60	85
Gypsies, Balkans	M	8	.86	.40	1.84	22
Armenians	M	12	.82	.72	.94	77
Germans, Balkans	M	7	.46	.19	1.13	17
Bulgarians	M	20	.69	.43	1.09	39

x, Face Breadth
y, Upper Face Length

LIVING, Means						
Chinese, Turkestan Pamirs	M	25	-.07	-.17	-.03	567

x, Face Breadth
y, Upper Facial Index

Group	Sex	N	r xy	bx	bl
SKULLS					
Batavia, Java	M	14	-.66	-.45	-.96
Spitalfields	M	28	-.58	-.76	-.44

x, Face Breadth
y, Minimum Frontal Breadth

Group	Sex	N	r xy	r xy (Vx/Vy)	r xy (Vy/Vx)	Ratio in Lags
LIVING						
North Sweden	M	4795	.50	.45	.56	81
West Sweden	M	13222	.52	.44	.61	72
East Sweden	M	15497	.52	.44	.61	72
South Sweden	M	8714	.53	.46	.62	74
Swedish Cities	M	4755	.54	.46	.64	72
All Swedish Groups	M	47387	.53	.45	.62	74
SKULLS						
Egyptians	M	700	.42	.35	.50	70
Egyptians	F	400	.49	.43	.55	78
Teneriffe	M	245	.44	.35	.55	64
Greifenberg	M	219	.46	.51	.41	124
Merovingian	M	72	.34	.36	.32	112
Merovingian	F	34	.19	.26	.14	186

x, Face Length
y, Upper Face Length

LIVING						
Chinese, Turkestan, Pamirs	M	25	.52	.50	.54	93

TABLE 4

x, Face Breadth
y, Head Breadth, l, $\frac{x}{y}$
N, Negro; I, Indian; W, White

LIVING						
English Criminals	M	3000	.62	.56	.89	61
U. S. Negro	M	106	.45	.40	.50	80
N (I)	M	36	.77	.55	1.08	52
NNW	M	129	.62	.53	.73	73
NNW (I)	M	51	.65	.67	.63	106
NW	M	95	.52	.38	.71	54
NW (I)	M	57	.70	.62	.80	78
SKULLS						
Egyptians	M	700	.37	.39	.36	108
Egyptians	F	400	.34	.37	.31	119
Greifenberg	M	219	.60	.45	.46	116
Merovingian	M	72	.54	.60	.48	125
Merovingian	F	34	.48	.35	.16	53
Teneriffe	M	245	.52	.61	.44	140

Group	Sex	N	bx	bl	r xl
Egyptians	M	400	--	--	-.58
Egyptians	F	700	--	--	-.62
Peruvians, 7 group	M		--	.11n	.33
Eskimo, 19 groups	M		.621	.26n	.40
Eskimo, 17 groups	F		.471	.25n	.34
Roumanians, 18 groups	M		.62	.25	.39
English Criminals	M	3000	--	--	-.34

LAG IN HEAD AND SKULL

TABLE 5

x, Face Breadth i, Y
y, Nose Breadth X

Group	Sex	N	r xy	r xy (Vx/Vy)	r xy (Vy/Vx)	Ratio in Lags
SKULLS						
Egyptian	M	700	.25	.12	.51	24
Egyptian	F	400	.23	.12	.45	27
Merovingian	M	162	.11	.05	.21	24
Pecos	M	101	.10	.06	.16	18
African tribes, means	M	13	.78	.45	1.34	34
			kx	ki	r xi	
Egyptians	M	700	--	--	-.24	
Egyptians	F	400	--	--	-.28	
French	1	46	.40x	.06x	.16	
Hungarian		20	-.13i	-.02x	-.04	
Slavs		31	.54i	.03x	.12	
Chinese, Peking		25	-.19i	-.06x	-.11	
Chinese, Formosa		25	.81i	.18x	.38	
Negro, West Africa		20	1.25i	.20x	.51	
Negro, East Africa		15	.68i	.14x	.31	
Egyptians, Ancient		50	-.12i	-.01x	-.04	
Peruvians		31	-2.27i	-.10x	-.48	
New Pomerania		15	2.06i	.11x	.49	
Banning		15	.43i	.13x	.24	
Javanese		12	-.85i	-.10x	-.30	
	Sex	N	r xy	r xy (Vx/Vy)	r xy (Vy/Vx)	Ratio in Lags
x, Face Breadth y, Biorbital Breadth						
LIVING						
Roumanians, Means	M	16	.54	.46	.63	73
x, Facial Breadth y, Orbital Width, Right						
SKULLS						
Batavia, Java	M	32	.40	.42	.37	114
Batavia, Java	M	35	.38	.69	.22	295

TABLE 5A

x, Foramen Magnum Length
y, Foramen Index

SKULLS			r xy	kx	ki
Spitalfields	F	54	-.36	-.14	-.96
Spitalfields	F	8	.15	.11	.20
Spitalfields	M	30	-.39	-.17	-.90
Spitalfields	M	31	-.80	-.15	-2.52
Spitalfields	F	7	-.85	-.20	-3.61
Spitalfields	M	12	-.08	-.07	-.08
Spitalfields	M	21	-.61	-.25	-1.46
Spitalfields	M	57	-.42	-.18	-.99
Spitalfields	M	89	-.69	-.43	-1.12

TABLE 6

x, Head Height
y, Face Height

Group	Sex	N	r xy	r xy (Vx/Vy)	r xy (Vy/Vx)	Ratio in Lags
SKULLS						
Tenerife	M	245	.25	.14	.46	30
Egyptian	M	700	.18	.12	.29	41
Egyptian	F	400	.18	.11	.31	35
Merovingian	M	74	.26	.19	.36	53
Gallo-Roman	M	105	.10	.07	.13	54
Gallo-Roman	F	118	.18	.11	.30	37
Greifenberg	M	226	.28	.19	.44	43
32 Ethnic Groups	M & F		.07	.05	.12	42
x, Height y, Face Breadth						
Tenerife	M	245	.23	.21	.26	81
Egyptian	M	700	.23	.25	.22	114
Egyptian	F	400	.28	.26	.30	87
41 Ethnic Groups	M & F		.09	.09	.08	112
x, Head Height y, Minimum Frontal Breadth						
Pecos Indian, Normal	M	34	.69	.90	.96	52
Pecos Indian, Deformed	M	75	.34	.25	.47	53
Andaman	M	12	.23	.15	.35	43
Andaman	F	12	-.14	-.11	-.18	61
38 Ethnic Groups	M & F		-.14	-.17	-.11	155
x, Head Length y, Minimum Frontal Breadth						
Tenerife	M	245	.40	.22	.71	31
Pecos, Normal	M	44	.36	.25	.52	48
Pecos, Deformed	M	85	.23	.23	.23	100
Andaman	M	12	.45	.28	.54	23
Andaman	F	12	-.46	-.42	-.50	84
Greifenberg	M	219	.22	.20	.25	80
38 Ethnic Groups	M & F		.32	.33	.31	106
x, Head Breadth y, Face Height						
Tenerife	M	245	.45	.24	.87	28
Egyptian	M	700	.14	.08	.25	32
Egyptian	F	400	.19	.11	.32	34
32 Ethnic Groups	M & F		.50	.45	.56	80

TABLE 6
(Cont.)

x, Face Breadth
y, Orbit Breadth

Group	Sex	N	r xy	r xy (Vx/Vy)	r xy (Vy/Vx)	Ratio in Lags
SKULLS						
Pecos Indian	M	98	.60	.58	.68	94
Merovingian	M	162	.20	.15	.26	58
x, Face Height y, Nose Height						
Pecos Indian	M	110	.67	.68	.66	102
Merovingian	M	213	.68	.67	.70	96
Egyptian	M	700	.71	.74	.68	109
Egyptian	F	400	.71	.75	.66	114
x, Face Height y, Orbit Height						
Pecos Indian	M	103	.49	.57	.42	136
Merovingian	M	213	.45	.44	.46	96
x, Face Breadth y, Bigonial Breadth						
Pecos Indian	M	79	.55	.35	.87	40
Merovingian	M	72	.53	.42	.67	63
Merovingian	F	34	.37	.20	.69	29
x, Face Height y, Skull Base (Basion-Alveon)						
Pecos Indian	M	89	.30	.44	.20	220
Egyptian	M	700	.27	.31	.24	129
Egyptian	F	400	.26	.33	.21	157
31 Ethnic Groups	M & F		.12	.20	.08	250
x, Face Breadth y, Skull Base						
Pecos Indian	M	79	.27	.32	.22	146
40 Ethnic Groups	M & F		.26	.24	.27	89

TABLE 7

x, Head Length
y, Face Height

SKULLS						
Egyptian	M	700	.26	.14	.50	28
Egyptian	F	400	.29	.14	.62	23
Merovingian	M	74	.27	.14	.52	27
Merovingian	F	34	-.32	-.18	-.58	31
Greifenberg	M	226	.22	.14	.36	39
Tenerife	M	245	.48	.20	1.10	18
x, Head Length y, Face Breadth						
Egyptian	M	700	.38	.33	.44	75
Egyptian	F	400	.31	.22	.42	52
Merovingian	M	167	.19	.16	.22	73
Greifenberg	M	219	.18	.17	.18	94
Tenerife	M	245	.55	.38	.78	49
41 Ethnic Groups	M & F		.49	.42	.57	74
English Criminals*	M	3000	.40	.35	.48	73

*Living

TABLE 8

x, Foramen Magnus Length
y, Various Measures

SKULLS						
			y, Palate Length			
Hylam Chinese	M	39	.11	.09	.14	64
East Asiatic, 12 Groups	M		.87	.96	.78	123
			y, Skull Length			
Europeans, 6 Groups	M		-.11	-.20	-.06	33
			y, Nose Height			
Easter Island	M	36	-.54	-.54	-.53	102

i, $\frac{\text{Foramen Breadth}}{x}$

			r xi
English	M	33	-.38
English	F	81	-.45
Europeans, 5 Groups	M		-.86
Europeans, 6 Groups	M		-.79
Badarian	M	56	-.39
Easter Island	M	35	-.82
Easter Island	F	16	-.75
Hylam Chinese	M	39	-.84
Java, 6 Groups	M		-.40
East Asiatic, 13 Groups	M		-.42

TABLE 9

x, Head Breadth
i, Cephalic Index

LIVING			kx	ki	r xi
New Guinea	M	220	.721	.56x	.63
French	M	660	--	.51x	.70
French	F	340	--	.60x	.73
Naqada	M	130	--	.36x	.59
Naqada	F	169	--	.46x	.70
English	M	131			.68
English	M	130			.60

LAG IN HEAD AND SKULL

TABLE 10

x, Head Length
l, Cephalic Index

Group	Sex	N	bx	bl	r xl
LIVING					
Swedish, 25 Groups	M		-1.01l	-.51x	-.72
Danish	M	88	-0.93	-.33x	-.30
German	M	1698	--	--	-.51
German	F	1497	--	--	-.52
Cambridge Students	M	1000	--	--	-.55
English Criminals	M	3000	--	--	-.51
English	M	1306	--	--	-.49
Finn, Karelia	M	28	-1.18l	-.43x	-.71
Finn, Tavastlands	M	36	-0.81l	-.33x	-.52
Finn, Tavastlands	F	31	-0.73l	-.17x	-.35
Turk, 7 Groups	M & F		-1.20l	-.64x	-.87
Transjordania, 20 Groups	M		-1.53l	-.43x	-.82
Alsace	M	22	0.17l	.17x	.15
Kattkoumouks	M	33	-0.84l	-.37x	-.56
Tadjik	M	14	-0.18l	-.05x	-.69
Cochin-Chine	M	21	-0.69l	-.49x	-.57
Cambodian	M	11	-0.97l	-.50x	-.70
Tonkinese	M	21	-1.11l	-.59x	-.66
Peruvian, Piro	M	23	-1.97l	-.10x	-.44
Peruvian, Machayenga	M	19	-2.43l	-.35x	-.92
Peruvian, Lipibo	M	14	-0.70l	-.39x	-.52
Peruvian	M	145	-1.14l	-.32x	-.60
Choctaw	M	33	-1.71l	-.32x	-.74
Choctaw	F	17	-1.92l	-.34x	-.80
Eskimo, 24 Groups	M		-0.84l	-.58x	-.70
Negro, U. S.	M	20	-0.97l	-.38x	-.82

TABLE 11

x, Head Length
l, Cephalic Index

SKULLS	Sex	N	bx	bl	r xl
Marne, Neolithic	M	19	-1.30l	-.52x	-.82
Marne, Neolithic	F	18	-1.11l	-.41x	-.68
Gauls, Ancient	M	36	-0.51l	-1.27x	-.80
Gauls, Ancient	F	25	-0.45l	-1.05x	-.68
French	M	37	-0.50l	-0.26x	-.36
French	M	860	--	--	-.65
French	F	340	--	--	-.72
French, Saône-et-Loire	M	14	-1.39l	-0.34x	-.69
French Murderers	M	24	-0.52l	-0.22x	-.34
Basque	M	23	-0.87l	-0.18x	-.40
Basque	F	18	-0.67l	-0.36x	-.49
Basque	F	15	-1.29l	-0.28x	-.60
Basque	M	14	-1.97l	-0.15x	-.54
Alsatians	[illegible]	87	--	-0.20x	--
Alsatians	M	57	--	-0.44x	--
Alsatians	F	63	--	-0.54x	--
Tenerife	M	72	-1.75l	-0.16x	-.52
Tenerife	M	18	-0.82l	-0.03x	-.16
Sardinian	M	11	-1.62l	-0.39x	-.80
Italian	M	15	--	-0.15x	--
English	M	131	--	--	-.55
English	F	130	--	--	-.56
British Long Barrows	M	25	-0.28	-0.41x	-.34
British Long Barrows	M	20	-0.38l	-0.50x	-.44
British Round Barrows	M	25	-0.35l	-0.65x	-.47
British Chambered Long Barrows	M	35	-0.70l	-0.77x	-.73
British Chambered Long Barrows	F	21	-0.50l	-1.14x	-.76
Finn, Helsingfors	M	41	-1.26l	-0.38x	-.65
Finn, Helsingfors	F	31	-0.64l	-0.29x	-.43
Baden	M	11	--	-0.42x	--
Baden	F	12	--	-0.30x	--
Galician	M	17	-0.98l	-0.33x	-.56
Lothringen	M	15	--	-0.61x	--
Russian, Kourgane	F	15	-2.19l	-0.24x	-.57
Egyptian	M	48	-1.71l	-0.34x	-.63
Egyptian	F	42	-1.22l	-0.42x	-.72
Egyptian	M	700	--	--	-.48
Egyptian	F	400	--	--	-.42
Egyptian, Naqada	M	130	--	-0.27x	-.55
Egyptian, Naqada	F	109	--	-0.31x	-.56
Egyptian, Naqada	M	139	--	--	-.55
Egyptian, Naqada	F	183	--	--	-.61
Indians, Ohio	F	25	-0.91l	-0.66x	-.77
Indians, Peru	M	157	-1.00l	-.56x	-.75
Indians, Peru	F	282	-0.93l	-.59x	-.74
Indians, Peru	M	32	-1.16l	-.33x	-.62
Negro, Kamerun	M	13	--	-.46x	--

TABLE 12

x, Head Length
y, Head Breadth, l, $\frac{y}{x}$

Group	Sex	N	r xy	r xl	r xy (Vx/Vy)	r xy (Vy/Vx)	Ratio in Lags
LIVING							
Egyptians (26 yrs or over)							
Province A	M	384	.21	-.55	.18	.24	75
Province B	M	504	.21	-.65	.21	.21	100
Province C	M	526	.21	-.59	.19	.23	83
Province D	M	491	.23	-.54	.20	.25	80
Province E	M	610	.23	-.63	.23	.23	100
Province F	M	717	.23	-.61	.23	.23	100
Province G	M	643	.24	-.57	.22	.26	85
Province H	M	602	.24	-.59	.23	.25	92
Province I	M	515	.25	-.59	.24	.26	92
Province J	M	262	.26	-.53	.22	.30	73
Province K	M	326	.28	-.57	.25	.30	83
Province L	M	824	.29	-.56	.27	.31	87
Province M	M	295	.30	-.55	.28	.33	85
Province N	M	887	.31	-.58	.30	.32	94
Province O	M	1104	.32	-.54	.30	.34	88
Province P	M	127	.33	-.43	.26	.42	62
Province Q	M	413	.37	-.50	.33	.41	80

TABLE 13

x, Head Length
y, Head Breadth

Group	Sex	N	r xy	r xy (Vx/Vy)	r xy (Vy/Vx)	Ratio of Lags
LIVING						
English Criminals	M	3000	.40	.38	.42	90
Cambridge Students	M	1000	.34	.33	.36	92
Aberdeen, Normal	M	787	.42	.39	.45	86
Aberdeen, Insane	M	293	.59	.58	.60	96
Banff, Normal	M	105	.45	.43	.47	93
Banff, Insane	M	84	.39	.36	.41	88
Scottish Soldiers	M	2887	.36	.35	.38	92
Scottish, Insane	M	4381	.48	.46	.51	89
Germans	M	1698	--	--	.33	--
Germans	F	1497	--	--	.31	--
North Sweden	M	4795	.25	.23	.27	86
West Sweden	M	13222	.28	.27	.29	92
East Sweden	M	15497	.26	.25	.27	92
South Sweden	M	8714	.32	.29	.35	83
Cities, Sweden	M	4159	.28	.26	.30	88
All Swedish	M	47387	.27	.25	.29	88
SKULLS						
Grafenberg	M	219	.07	.07	.07	114
Tenerife	M	245	.59	.49	.71	69
Pecos, deformed	M	91	-.13	-.16	-.11	146
Pecos, deformed	F	68	-.30	-.41	-.22	186
Pecos, normal	M	43	.09	.09	.09	100
Pecos, normal	F	25	-.52	-.42	-.63	67
Andaman	M	12	-.32	-.28	-.36	78
Andaman	F	12	.34	.45	.26	173
Egyptian	M	700	.40	.36	.44	82
Egyptian	F	400	.38	.30	.47	64
43 Ethnic Groups			-.32	-.18	-.58	31
English, Moorfields	F	57	.62	.53	.72	73
English, Whitechapel	F	130	.35	.34	.36	95

TABLE 14

x, Head Length
y, Head Breadth, l, $\frac{y}{x}$ Worchester, Massachusetts

Age Groups	N	r xy	r xl	r xy (Vx/Vy)	r xy (Vy/Vx)	Ratio of Lags
BOYS						
6 Years	105	.30	-.61	.31	.29	107
7	142	.18	-.68	.20	.16	125
8	120	.14	-.62	.13	.15	87
9	167	.29	-.63	.31	.27	115
10	157	.17	-.62	.16	.18	89
11	151	.12	-.65	.12	.13	92
12	177	.30	-.50	.26	.35	74
13	168	.15	-.68	.16	.14	114
14	154	.14	-.60	.16	.12	112
15	152	.14	-.68	.15	.13	115
16	96	.28	-.62	.29	.27	107
17	49	.18	-.62	.17	.19	89
GIRLS						
6 Years	64	.30	-.62	.31	.29	107
7	101	.09	-.73	.10	.08	125
8	105	.16	-.69	.18	.15	120
9	118	.30	-.61	.31	.29	107
10	160	.25	-.63	.26	.24	108
11	158	.29	-.53	.26	.33	79
12	165	.24	-.57	.22	.26	85
13	142	.32	-.63	.35	.29	121
14	115	.39	-.52	.37	.41	90
15	109	.26	-.56	.24	.29	83
16	91	.43	-.48	.40	.47	85
17	69	.29	-.60	.29	.29	100

TABLE 15

x, Head Breadth
y, Head Height

Group	Sex	N	r xy	r xy (Vx/Vy)	r xy (Vy/Vx)	Ratio in Lags
LIVING						
Aberdeen, Normal	M	787	.32	.24	.43	56
Aberdeen, Insane	M	293	.40	.34	.46	72
Banff, Normal	M	105	.36	.31	.42	73
Banff, Insane	M	84	.47	.36	.60	60
Scottish Soldiers	M	2887	.30	.25	.35	71
Scottish, Insane	M	4381	.35	.31	.40	76
Germans	M	1735	--	.22	.43	52
Germans	F	1395	--	.20	.37	54
U. S. Negro	M	108	.42	.46	.38	121
N (I)*	M	38	.29	.30	.28	107
NNW*	M	149	.28	.34	.23	148
NNW (I)*	M	51	.02	.03	.03	100
NW*	M	95	.26	.28	.24	117
NW (I)*	M	57	.07	.07	.06	117

*N, Negro
I, Indian
W, White

Group	Sex	N	r xy	r xy (Vx/Vy)	r xy (Vy/Vx)	Ratio in Lags
SKULLS						
43 Ethnic Groups	M & F		-.13	-.19	-.09	211
Whitechapel	F	115	.34	.30	.38	79
Moorfields	F	44	.29	.29	.29	101
Tenerife	M	245	.30	.28	.32	87
Pecos, Normal	M	33	.42	.40	.45	89
Pecos, Normal	F	21	.41	.60	.28	214
Pecos, Deformed	F	53	.34	.45	.26	173
Pecos, Deformed	M	78	.25	.28	.22	127
Egyptian^2	M	700	.33	.31	.36	86
Egyptian^2	F	400	.34	.33	.34	97
Egyptian^3	M	700	.46	.43	.48	90
Egyptian^3	F	400	.41	.41	.41	100
Andaman	M	12	-.03	-.02	-.04	50
Andaman	F	12	.29	-.27	-.32	84

2, Basio-Bregmatic Height - 3. Auricular Height

LAG IN HEAD AND SKULL

TABLE 16

x, Head Breadth
y, Minimum Frontal Breadth. l, $\frac{y}{x}$

Group	Sex	N	r xy	r xy (Vx/Vy)	r xy (Vy/Vx)	Ratio of lags
SKULLS						
Egyptians	M	700	.33	.26	.41	63
Egyptians	F	400	.29	.24	.36	67
38 Ethnic Groups	M & F		.33	.50	.22	227
Tenerife	M	245	.46	.31	.68	46
Merovingian	M	72	.34	.41	.29	141
Merovingian	F	34	.26	.26	.26	100
Pecos, normal	M	39	.48	.32	.72	44
Pecos, deformed	M	82	.38	.31	.45	69
Andaman	M	12	-.09	-.05	-.16	31
Andaman	F	12	0	0	0	--

Group	Sex	N	kx	kl	r xl
Aino	?	30	-.40l	-.18x	-.26
Dayos	?	14	-.67l	-.16x	-.35
Aleutian	M	20	-.51l	-.19x	-.31
Aleutian	F	26	-1.06l	-.37x	-.63
Japanese	?	17	-.58l	-.21x	-.35
Negro	?	13	-.10l	-.05x	-.07
Egyptians	?	20	-.63l	-.44x	-.53
Australian	M	21	-.80l	-.35x	-.53
Australian	F	15	-.78l	-.25x	-.44
Australian (M mixture)	?	15	-.66l	-.24x	-.39
Huron, Iroquois	?	12	-.40l	-.03x	-.32
Egyptians	M	700	--	--	-.45
Egyptians	F	400	--	--	-.48

TABLE 17

x, Head Length
y, Head Height

Group	Sex	N	r xy	r xy (Vx/Vy)	r xy (Vy/Vx)	Ratio of Lags
LIVING						
Aberdeen, normal	M	787	.34	.23	.48	48
Aberdeen, insane	M	297	.35	.29	.42	70
Banff, normal	M	105	.19	.15	.23	68
Banff, insane	M	84	.42	.31	.58	53
Scottish Soldiers	M	2687	.34	.27	.42	65
Scottish, insane	M	4381	.38	.31	.46	67
Germans	M	1732	--	.13	.32	41
Germans	F	1397	--	.17	.40	42
Choctaw	M	31	--	--	.54	--
Choctaw	F	17	--	--	.62	--
U. S. Negro	M	102	.37	.39	.35	111
*N(I)	M	33	.29	.26	.32	81
NNW	M	112	.38	.39	.37	105
NNW (I)	M	44	.33	.43	.25	172
NW	M	87	.25	.27	.23	117
NW (I)	M	45	.52	.46	.58	79

*N, Negro - I, Indian - W, White

Group	Sex	N	r xy	r xy (Vx/Vy)	r xy (Vy/Vx)	Ratio of Lags
SKULLS						
43 Ethnic Groups	M & F		.62	.48	.78	62
*Egyptians	M	700	.38	.32	.46	70
*Egyptians	F	400	.19	.15	.24	62
**Egyptians	M	700	.39	.34	.47	72
**Egyptians	F	400	.32	.25	.39	64
Andaman	M	12	.02	.02	.03	67
Andaman	F	12	.32	.39	.26	150
Tenerife	M	245	.52	.40	.67	60
Pecos, normal	M	34	.42	.41	.43	95
Pecos, normal	F	21	.25	.31	.21	148
Pecos, deformed	M	80	.13	.18	.10	180
Pecos, deformed	F	55	.31	.43	.22	196
Moorfields	F	44	.24	.21	.28	74
Whitechapel	F	120	.42	.37	.49	76

*Basio-bregmatic - **Auricular

TABLE 18

x, Head Length
y, Head Height l, $\frac{y}{x}$
Auricular Height

Group	Sex	N	kx	kl	r xl
SKULLS					
Gauls, Ancient	M	26	-.48l	-.90x	-.65
Gauls, Ancient	F	21	-.66l	-.48x	-.56
Long Barrows, Falsten & Mohn	--	17	-.25l	-.55x	-.37
British Long Barrows	M	23	-.45l	-1.13x	-.71
British Round Barrows	M	24	-.25l	.46x	-.34
British Chambered Barrows	M	33	-.91l	-.63x	-.75
British Chambered Barrows	F	16	-.23l	-1.17	-.52
Aleutians	?	23	--	.04x	--
Galicians	?	10	-1.25l	-.20x	-.50
Egyptians	M	700	--	--	-.44
Egyptians	F	400	--	--	-.46
LIVING					
Choctaw	M	31	-.63l	-.44x	-.17
Choctaw	F	17	--	--	-.78
Basio-bregmatic Height					
SKULLS					
Naqada	M	131	--	-.16x	-.33
Naqada	F	166	--	-.27x	-.51
Egyptian	M	700	--	--	-.43
Egyptian	F	400	--	--	-.52
English	M	120	--	--	-.48
English	F	117	--	--	-.48

TABLE 19

x, Horizontal Circumference
y, Head Length

Group	Sex	N	r xy	r xy (Vx/Vy)	r xy (Vy/Vx)	Ratio in Lags
LIVING						
Oxford Students, 18 years	M	129	.83	.61	1.12	55
Oxford Students, 19 years	M	330	.80	.64	1.00	64
Oxford Students, 20 years	M	209	.86	.70	1.06	66
Oxford Students, 21 years	M	137	.86	.70	1.05	67
Oxford Students, 22 years	M	55	.80	.68	.94	72
Germans	M	1721	--	--	.88	--
Germans	F	1389	--	--	.76	--
SKULLS						
Greifenberg	M	219	.81	.54	1.22	44
Egyptians	M	700	.88	.76	1.03	74
Egyptians	F	400	.87	.76	.98	78

x, Horizontal Circumference
y, Head Breadth

Group	Sex	N	r xy	r xy (Vx/Vy)	r xy (Vy/Vx)	Ratio in Lags
LIVING						
Germans	M	1721	--	--	.85	--
Germans	F	1389	--	--	.74	--
SKULLS						
Greifenberg	M	219	.55	.39	.78	49
Egyptian	M	700	.63	.49	.82	60
Egyptian	F	400	.66	.47	.94	50

x, Horizontal Circumference
y, Transverse Arc

Group	Sex	N	r xy	r xy (Vx/Vy)	r xy (Vy/Vx)	Ratio in Lags
Egyptians	M	700	.59	.49	.71	69
Egyptians	F	400	.52	.42	.65	65
Pecos Indian, normal	M	35	.50	.38	.65	58
Pecos Indian, normal	F	86	.44	.31	.63	49
Pecos Indian, deform	M	69	.25	.20	.32	62

x, Horizontal Circumference
y, Saggital Arc

Group	Sex	N	r xy	r xy (Vx/Vy)	r xy (Vy/Vx)	Ratio in Lags
Egyptians	M	700	.75	.60	.96	62
Egyptians	F	400	.68	.55	.84	65
Pecos Indian, normal	M	32	.70	.46	1.06	43
Pecos Indian, normal	F	84	.79	.62	1.01	62
Pecos Indian, deform	M	81	.81	.69	.94	73

x, Transverse Arc
y, Saggital Arc

Group	Sex	N	r xy	r xy (Vx/Vy)	r xy (Vy/Vx)	Ratio in Lags
Egyptians	M	700	.65	.62	.69	90
Egyptians	F	400	.59	.59	.59	100
Pecos Indian, normal	M	32	.28	.24	.32	75
Pecos Indian, deform	M	82	.30	.33	.27	122

TABLE 20

x, Nasal Height
y, Nasal Breadth l, $\frac{y}{x}$

Group	Sex	N	r xy	r xy (Vx/Vy)	r xy (Vy/Vx)	Ratio in Lags
SKULLS						
Egyptians	M	700	.24	.19	.31	61
Egyptians	F	400	.20	.16	.27	59
Pecos Indian	M	124	-.09	-.06	-.11	55
Pecos Indian	F	86	.18	.12	.29	41

Group	Sex	N	kx	kl	r xl
Hungarians		20	-.29l	-.67x	-.44
Slavs		31	-.50l	-.70x	-.59
French		46	-.37l	-.65x	-.49
Basques	M	23	-.16l	.24x	-.20
Basques	M	14	.11l	.21x	.15
Basques	F	15	-.31l	-.40x	-.35
Basques	F	15	-.69l	-.65x	-.67
Sardinians	M	11	-.44l	-.70x	-.55
Kourganes, Russia		14	-.16l	-.29x	-.21
Anglo-Saxons	M	19	-.17l	-.31x	-.23
Anglo-Saxons	F	19	-.47l	-.38x	-.42
Early Mediterranean					
Means of 7 Groups	M		-.27l	-.46x	-.35
Means of 7 Groups	F		-.58l	-1.56x	-.95
Predynastic Egyptian Means of 10 Groups	M		-.72l	-.19x	-.37
Egyptian, after 5th Dynasty Means of 6 Groups	M		-.90l	-.25x	-.48
Middle & Late Predynastic Egyptians Means of 8 Groups	M		.67l	.45x	.55
Egyptians & Others Means of 7 Groups	M		-.26l	-2.34x	.78
Means of 6 Groups	F		-.00l	.18x	-.01
Ancient Egypt	M	31	-.55l	-1.44x	-.89
Ancient Egypt	F	10	-.39l	-.87x	-.58
Ancient Egypt	F	85	-.10l	-.40x	-.20
Thebes		50	-.14l	-.56x	-.28
Naqada	M	89	--	--	-.71
Naqada	F	116	--	--	-.69
Negroes, Kenya	M	41	--	--	-.72
Negroes, East Africa	M	15	-.43l	-1.38x	-.77
Negroes, Kamerun & Sudan	M	20	-.21l	-.95x	-.45

LAG IN HEAD AND SKULL

TABLE 20
(Cont.)

X: Nasal Height
Y: Nasal Breadth, L, Y/X

Group	Sex	N	bx	bl	r xl
SKULLS					
Indians, Peru		30	-.75L	-.66m	-.71
Indians, Peru	M	81	--	-.77m	--
Indians, Peru	F	40	--	-1.15m	--
Indians, Ohio	M	33	-.28L	-.87m	-.50
Indians, Ohio	F	20	-.40L	-1.80m	-.84
Indian, Algonkin and Iroquois					
Mean of 5 groups	M & F		-.05L	-.11m	-.08
Andaman	M	18	-.28L	-.44m	-.35
Andaman	F	11	-.08L	-.14m	-.10
Easter Island	M	42	--	--	-.02
Easter Island	F	19	-.39L	1.01	-.63
Australian, Means of 6 Groups	M		-.01L	-.01m	-.03
18 Ethnic Groups	M		-.30L	-2.43m	-.66
13 Ethnic Groups	F		-.35L	-2.16m	-.67
New Pomerania		15	.44L	-1.62m	-.55
Japanese		18	.41L	-1.05m	-.66
Chinese, Peking		25	.65L	-.90m	-.77
Chinese, Formosa		25	.76L	-.12m	-.55
Peking		14	.22L	-.68m	-.35
LIVING					
Aissor, Armenia	M	28	-.42L	-.91m	-.62
Tats (Tadjik) Caucasus	M	14	-.30L	-.94m	-.53
Kaitkouvits, Caucasus	M	13	-.28L	-1.03m	-.78
Cambodians	M	11	-.37L	-1.76m	-.64
Cochin-Chinese	M	21	-.54L	-2.14m	-.72
Tonkinese	M	21	-.09L	-.30m	-.16
Negroes, American	M	18	-.27L	-2.31m	-.79
Indians, Pima	M	22	-.31L	-.69m	-.45
Indians, Sioux	M	16	-.14L	-2.32m	-.57
Indians, Arawak	M	19	0	.11m	.02
Indians, Peru	M	145	-.13L	-.80m	-.32
Indians, Peru					
Means of 7 Groups	M & F		-.20L	-1.72m	-.58

TABLE 21
Lag in Traits of American Negroes and Hybrid Males
(Herskovits, 1930)

X: Nose Breadth
Y: Inter-pupillary Distance
N: Negro - N; White - W; I. Indian

Group	N	r xy	r xl	r xy (Vx/Vy)	r xy (Vy/Vx)	Ratio of Lags
LIVING						
N	108	.10	-.21	.14	.07	200
N (I)	35	.31	-.41	.53	.18	294
NNW	125	.27	-.31	.55	.25	220
NNW (I)	51	.46	-.10	.64	.18	316
NW	91	.31	-.16	.45	.21	219
NW (I)	26	.21	-.27	.46	.11	418
NWW & NWW (I)	60	.02	-.45	.004	.01	400
X. Nose Breadth Y. Thickness of Lips						
N	109	.28	-.19	.08	.52	15
N (I)	35	.37	-.13	.18	.76	24
NNW	125	.26	-.17	.11	.60	18
NNW (I)	51	.45	-.25	.38	.62	52
NW	95	.33	-.09	.15	.72	18
NW (I)	57	-.08	-.33	-.04	-.16	27
NWW & NWW (I)	61	.37	-.22	.21	.64	33
X. Nose Breadth Y. Ear Height						
N	108	.16	-.72	.13	.19	74
N (I)	35	.15	-.40	.16	.12	133
NNW	129	.42	-.29	.52	.35	153
NNW (I)	51	.12	-.12	.21	.07	300
NW	95	-.10	-.68	-.12	-.08	150
NW (I)	57	.20	-.31	.18	.10	180
NWW & NWW (I)	61	.22	-.31	.41	.12	342
X. Ear Height Y. Thickness of Lips						
N	108	.08	-.34	.04	.02	200
N (I)	36	.41	-.03	.18	.93	19
NNW	129	-.15	-.45	-.05	-.40	12
NNW (I)	51	.08	-.38	.03	.02	150
NW	95	-.02	-.35	-.01	-.01	100
NW (I)	57	.27	.08	.08	1.00	8
NWW & NWW (I)	61	.13	-.18	.04	.42	10

TABLE 22

X: Biorbital Breadth
Y: Interorbital Breadth

Group	Sex	N	r xy	r xy (Vx/Vy)	r xy (Vy/Vx)	Ratio of Lags
LIVING. Means of Groups						
Jews, Balkans	M	6	.06	.07	.15	20
Gypsies, Balkans	M	6	.72	.65	.80	81
Albanians	M	11	.62	.20	.09	222
Germans, Balkans	M	7	.42	.51	1.25	42
Balkans	M	14	.19	.74	.27	259
Serbs	M	11	.75	.60	.94	64
Tatars	M	22	.29	.18	.26	123
Greeks	M	13	.52	.18	.85	22
Bulgarians	M	20	.56	.42	.75	56
Roumanians	M	18	.30	.80	.43	86
Laze, Black Sea	M	15	.39	.21	.95	35
Osmanli Turks	M	20	.43	.28	.67	42

TABLE 22
(Cont.)

X. Orbital Breadth
Y. Orbital Height L, Y/X

Group	Sex	N	r xy	r xy (Vx/Vy)	r xy (Vy/Vx)	Ratio of Lags
SKULLS,						
Egyptians	M	700	.26	.19	.36	51
Egyptians	F	400	.32	.28	.55	51
Pecos Indians	M	120	.36	.38	.36	109
Pecos Indians	F	83	.37	.53	.28	76
Whites	M	55	.36	.13	.57	46
Whites	F	43	.56	.35	.60	49
			bx	bl	r xl	
Basques	M	27	-.80L	-.49m	-.62	
Basques	M	16	-.00L	-.00m	-.00	
Basques	F	17	-.11L	-1.06m	-.35	
Basques	F	19	.03L	.23m	.28	
Sardinians	M	33	-.28L	-1.72m	-.71	
Kourgans, Russia		12	-.48L	-1.35m	-.61	
Nagada, R. Orbit	M	87	--	--	-.30	
Nagada, L. Orbit	M	81	--	--	-.29	
Nagada, R. Orbit	F	112	--	--	-.30	
Nagada, L. Orbit	F	104	--	--	-.35	
Egyptians	M	700	--	--	-.55	
Egyptians	F	400	--	--	-.32	
Egyptians, Means of 10 Groups	M		--	--	-.66	
Negroes, Kenya	M	45	--	--	-.22	
Andaman Islanders	M	12	-.21L	-1.25m	-.52	
Andaman Islanders	F	12	-.36L	-1.53m	-.63	
Batavia, Java	M	15	-.63L	-.64m	-.15	
Batavia, Java	M	13	-1.37L	-.26m	-.66	

TABLE 25

X. Palate Length
Y. Palate Breadth L, Y/X

			r xy	r xy (Vx/Vy)	r xy (Vy/Vx)	
SKULLS						
Pecos Indian	M	97	.43	.44	.42	105
Pecos Indian	F	65	.36	.40	.29	118
Egyptians	M	700	.14	.17	.18	95
Egyptians	F	400	.16	.15	.18	83
			bx	bl	r xl	
Aleutians	M	13	-.39L	-1.91m	-.87	
Egyptians	M	700	--	--	-.64	
Egyptians	F	400	--	--	-.61	
Nagada	M	73	--	--	-.45	
Nagada	F	105	--	--	-.39	
Hylam Chinese	M	39	--	--	-.76	
East Asiatic, 11 Groups	M		--	--	-.67	
Java, 5 Groups	M		--	--	-.61	

TABLE 24
Lag in Egyptian Skulls
(*Biometrika*, Vol. 16, .. 1924)

Y	Sex	700 Male - 400 Female			
		r xy	r xy (Vx/Vy)	r xy (Vy/Vx)	Ratio of Lags
X. Skull Length Skulls					
Nasal Height	M	.28	.15	.50	30
Nasal Height	F	.27	.14	.52	26
Nasal Breadth	M	.24	.10	.56	18
Nasal Breadth	F	.12	.05	.32	16
Palate Length	M	.35	.16	.75	22
Palate Length	F	.20	.08	.47	17
X. Skull Breadth					
Nasal Height	M	.11	.07	.19	37
Nasal Height	F	.15	.10	.25	40
Nasal Breadth	M	.11	.05	.24	21
Nasal Breadth	F	.07	.03	.15	20
X. Basio-Bregmatic Height					
Auricular Height	M	.73	.75	.70	107
Auricular Height	F	.73	.76	.71	104
Nasal Height	M	.36	.29	.61	47
Nasal Height	F	.14	.09	.31	29
Nasal Breadth	M	.06	.03	.11	27
Nasal Breadth	F	.08	.04	.16	25
X. Auricular Height					
Upper Face Height	M	.12	.08	.21	38
Upper Face Height	F	.13	.07	.22	32
Nasal Height	M	.07	.05	.11	45
Nasal Height	F	.04	.02	.06	33
X. Upper Face Height					
Nasal Breadth	M	.09	.07	.11	64
Nasal Breadth	F	.08	.07	.10	70
X. Horizontal Circumference					
Basio-Bregmatic Height	M	.36	.25	.51	49
Basio-Bregmatic Height	F	.26	.18	.38	47
Auricular Height	M	.47	.35	.65	52
Auricular Height	F	.37	.26	.53	50
X. Sagittal Arc					
Skull Length	M	.74	.81	.68	119
Skull Length	F	.70	.77	.63	122
Skull Breadth	M	.49	.48	.50	96
Skull Breadth	F	.48	.42	.55	76
Basio-Bregmatic Height	M	.47	.42	.53	81
Basio-Bregmatic Height	F	.49	.42	.56	75
Auricular Height	M	.66	.61	.71	86
Auricular Height	F	.65	.56	.72	78
Basion-Nasion Length	M	.11	.10	.14	71
Basion-Nasion Length	F	.06	.05	.08	62

LAG IN BODY DIMENSIONS

TABLE 24
(Cont.)

Lag in Egyptian Skulls
(Biometrika, Vol. 16, 1924)

y	Sex	700 Males - 400 Females r xy	r xy (Vx/Vy)	r xy (Vy/Vx)	Ratio of Lags
x, Sagittal Arc					
Upper Face Height	M	.16	.09	.27	33
Upper Face Height	F	.33	.07	.32	22
Face Breadth	M	.25	.22	.25	88
Face Breadth	F	.37	.13	.21	62
Arc, Nasion-Bregma	M	.69	.48	1.00	48
Arc, Nasion-Bregma	F	.68	.47	1.08	43
Arc, Bregma-Lambda	M	.60	.35	1.03	34
Arc, Bregma-Lambda	F	.38	.21	.67	31
Arc, Lambda-Opisthion	M	.53	.30	.93	32
Arc, Lambda-Opisthion	F	.49	.24	1.02	24
x, Arc, Nasion-Bregma					
Skull Length	M	.48	.76	.31	245
Skull Length	F	.62	.72	.25	288
Upper Face Height	M	.16	.16	.23	70
Upper Face Height	F	.17	.14	.21	67
Arc, Bregma-Lambda	M	.19	.16	.22	73
Arc, Bregma-Lambda	F	.11	.10	.13	77
Arc, Lambda-Opisthion	M	.15	.13	.19	68
Arc, Lambda-Opisthion	F	.11	.08	.14	57
x, Arc, Bregma-Lambda					
Skull Length	M	.36	.70	.20	350
Skull Length	F	.30	.58	.15	387
Upper Face Height	M	.01	.01	.01	100
Upper Face Height	F	.02	.02	.03	67
Arc, Lambda-Opisthion	M	-.16	-.16	-.16	100
Arc, Lambda-Opisthion	F	-.34	-.29	-.40	72
x, Arc, Lambda-Opisthion					
Skull Length	M	.51	.97	.27	359
Skull Length	F	.44	1.16	.19	579
Upper Face Height	M	.10	.19	.10	190
Upper Face Height	F	.05	.12	.05	120

TABLE 24A
Lag in Body Dimensions

x, Bisacromial Dia.
y, Bisacromial Dia./Height of Trunk

Group	Sex	N	r xy	kx	ky
LIVING					
Ethnic Groups, Means	M	10	.98	4.36	.22
x, Bi-iliac Dia. y, Bi-iliac Dia./Height of Trunk					
LIVING					
Ethnic Groups, Means	M	10	.96	3.63	.23
x, Bitrochanteric Dia. y, Bitrochanteric Dia./Stature					
LIVING					
Ethnic Groups, Means	M	10	.93	.72	1.22
x, Bitrochanteric Dia. y, Bitrochanteric Dia./Height of Trunk					
LIVING					
Ethnic Groups, Means	M	10	.68	3.19	.22

TABLE 25
Lag in Body Dimensions

x, Antero-Posterior Dia. of Chest
y, Trans. Dia. of Chest

Group	Sex	N	r xy	r xy (Vx/Vy)	r xy (Vy/Vx)	Ratio of Lags
LIVING						
Europeans, Means	M	6	.82	1.04	.64	162
x, Chest Circumference y, Leg Length						
LIVING						
Greeks, Means	M	13	.84	.41	1.74	24
Tartars, Means	M	24	.89	.55	1.46	38
x, Chest Circumference y, Span						
LIVING						
Gypsies, Balkans, Means	M	8	.99	.75	1.30	58

x, Chest Circumference
y, Chest Circumference/Stature

LIVING		Sex	N	r xy	kx	ky
Bulgarians	Means	M	20	-.65	-27.411	-.023
Bulgarians	Means	M	5	.02	1.471	.008
Serbs	Means	M	11	-.73	-40.351	-.018
Balkans	Means	M	10	-.06	-1.401	-.002
Solomon Islands		M	20	.96	2.321	.413

TABLE 25
(Cont.)

x: Chest Circumference
y: Pelvic Breadth

Group	Sex	N	r xy	r xy (Vx/Vy)	r xy (Vy/Vx)	Ratio of Lags
LIVING						
U. S. Soldiers	M	868,445	.31	.18	.52	35
California, 1 Month	M & F	47-59	.70	.29	.75	38
California, 3 Month	M & F		.71	.26	.79	33
California, 6 Month	M & F		.62	.30	.77	39
California, 9 Month	M & F		.71	.24	.75	32
California, 12 Month	M & F		.64	.32	.68	47
California, 15 Month	M & F		.75	.34	.71	46
California, 18 Month	M & F		.82	.35	.66	53
California, 24 Month	M & F		.65	.35	.57	61
California, 36 Month	M & F		.63	.40	.55	73
y. Stem Length						
California, 1 Month	M & F	47-59	.56	.57	.55	104
California, 3 Month	M & F		.63	.76	.51	149
California, 6 Month	M & F		.59	.64	.58	110
California, 9 Month	M & F		.61	.62	.59	105
California, 12 Month	M & F		.58	.64	.53	121
California, 15 Month	M & F		.60	.79	.58	136
California, 18 Month	M & F		.63	.75	.54	139
California, 24 Month	M & F		.60	.62	.41	151
California, 36 Month	M & F		.54	.58	.50	116

TABLE 26

Lag in Unilateral & Bilateral Lengths of Long Bones. Males.
(Münter, Biometrika, 28: 264-285, 1936)

No. = 43 - 152
M = Maximum Length
O = Oblique Length

Group	x		y		r xy	r xy (Vx/Vy)	r xy (Vy/Vx)	Ratio of Lags
Anglo-Saxon	Tibia	MR	Femur	MR	.87	1.04	.78	145
Anglo-Saxon	Tibia	MR	Femur	ML	.88	.98	.80	123
Anglo-Saxon	Tibia	MR	Femur	OR	.87	1.00	.75	133
Anglo-Saxon	Tibia	MR	Femur	OL	.86	.98	.76	130
Anglo-Saxon	Tibia	ML	Femur	MR	.87	1.14	.66	173
Anglo-Saxon	Tibia	ML	Femur	ML	.89	1.08	.73	148
Anglo-Saxon	Tibia	ML	Femur	OR	.86	1.09	.69	158
Anglo-Saxon	Tibia	ML	Femur	OL	.87	1.09	.70	156
Anglo-Saxon	Tibia	MR	Humerus	MR	.88	1.14	.62	185
Anglo-Saxon	Tibia	ML	Humerus	ML	.87	.93	.72	130
Anglo-Saxon	Tibia	ML	Humerus	OR	.83	.95	.73	132
Anglo-Saxon	Tibia	ML	Humerus	OL	.81	1.08	.61	178
French	Tibia	ML	Humerus	MR	.87	.86	.79	109
French	Tibia	ML	Humerus	ML	.83	.81	.84	96
Egyptian	Tibia	ML	Humerus	ML	.84	.77	.92	84
French	Tibia	MR	Humerus	MR	.85	.89	.81	110
French	Tibia	MR	Humerus	ML	.86	.79	.81	98
Egyptians	Tibia	MR	Humerus	ML	.89	.82	.97	85
Anglo-Saxon	Tibia	MR	Radius	MR	.81	.80	.82	98
Anglo-Saxon	Tibia	MR	Radius	ML	.79	.84	.75	112
French	Tibia	MR	Radius	ML	.80	.81	.78	104
French	Tibia	MR	Radius	MR	.84	.80	.87	92
French	Tibia	ML	Radius	MR	.77	.77	.76	102
French	Tibia	ML	Radius	ML	.76	.74	.82	90
Anglo-Saxon	Radius	MR	Humerus	MR	.90	.95	.85	112
Anglo-Saxon	Radius	MR	Humerus	ML	.89	1.07	.73	146
Anglo-Saxon	Radius	MR	Humerus	OR	.88	.94	.83	113
Anglo-Saxon	Radius	MR	Humerus	OL	.87	1.08	.70	153
Anglo-Saxon	Radius	ML	Humerus	MR	.86	.84	.87	97
Anglo-Saxon	Radius	ML	Humerus	ML	.83	.93	.73	127
Anglo-Saxon	Radius	ML	Humerus	OR	.80	.79	.80	99
Anglo-Saxon	Radius	ML	Humerus	OL	.78	.90	.68	133
Anglo-Saxon	Humerus	MR	Femur	MR	.89	1.01	.76	132
Anglo-Saxon	Humerus	MR	Femur	ML	.86	.91	.82	112
Anglo-Saxon	Humerus	MR	Femur	OR	.88	.97	.79	122
Anglo-Saxon	Humerus	MR	Femur	OL	.87	.94	.80	118
French	Humerus	MR	Femur	OR	.83	.71	.96	74
French	Humerus	MR	Femur	OL	.85	.78	.92	84
French	Humerus	ML	Femur	OR	.81	.79	.85	93
Egyptians	Humerus	ML	Femur	OR	.92	.91	.97	93
Egyptians	Humerus	ML	Femur	OL	.83	.89	.80	106
French	Humerus	ML	Femur	OL	.85	.84	.86	98
Anglo-Saxon	Humerus	ML	Femur	MR	.83	.95	.72	132
Anglo-Saxon	Humerus	ML	Femur	ML	.81	.86	.77	112
Anglo-Saxon	Humerus	ML	Femur	OR	.86	.93	.76	122
Anglo-Saxon	Humerus	ML	Femur	OL	.85	.92	.78	118
Anglo-Saxon	Humerus	OR	Femur	MR	.85	.92	.78	118
Anglo-Saxon	Humerus	OR	Femur	ML	.85	.85	.84	100
Anglo-Saxon	Humerus	OR	Femur	OR	.87	.90	.83	109
Anglo-Saxon	Humerus	OR	Femur	OL	.85	.88	.83	106
Anglo-Saxon	Humerus	OL	Femur	MR	.79	.77	.80	97
Anglo-Saxon	Humerus	OL	Femur	ML	.81	.73	.87	82
Anglo-Saxon	Humerus	OL	Femur	OR	.82	.77	.87	89
Anglo-Saxon	Humerus	OL	Femur	OL	.85	.79	.91	87

LAG IN BODY DIMENSIONS

TABLE 27

Long Bones

Males l, $\frac{\Sigma}{N}$
x, Femur Length

y	50 French r xy	50 French r xl	48 Chinese r xy	48 Chinese r xl	32 Aino r xy	32 Aino r xl	24 Nagada r xy	24 Nagada r xl
Tibia	.81	-.46	.89	-.15	.83	-.21	.92	-.43
Humerus	.84	-.51	.74	-.44	.86	-.30	.84	-.36
Radius	.74	-.50	.67	-.38	.79	-.26	.85	-.42
x, Tibia								
Humerus	.66	-.35	.69	-.51	.74	-.45	.85	-.18
Radius	.78	-.36	.76	-.37	.86	-.28	.85	-.25
x, Femur + Tibia								
Femur	.96	-.19	.98	-.06	.95	-.18	.98	-.43
Humerus + Radius	.91	-.42	.80	-.46	.89	-.39	.90	-.32
x, Humerus								
Radius	.84	-.23	.67	-.31	.78	-.24	.82	-.35
x, Humerus + Radius								
Humerus	.99	-.40	.93	-.06	.95	-.35	.97	-.36

TABLE 28

x, Forearm Length
y, Foot Length

Group	Sex	N	r xy	r xy (Vx/Vy)	r xy (Vy/Vx)	Ratio of Lags
English Criminals	M	3000	.80	.76	.84	90
Egyptians, Cairo	M	802	.76	.73	.79	92
y, Finger Length						
English Criminals	M	3000	.85	.78	.92	85
Egyptians, Cairo	M	802	.83	.71	.98	72
x, Foot Length y, Finger Length						
English Criminals	M	3000	.76	.73	.78	94
Egyptians, Cairo	M	802	.76	.68	.86	79

TABLE 28A

x, Length of Hand
y, Length of Leg

LIVING						
Banda, Central Africa Clans	M	15	.12	.15	.10	150
	F	15	.44	.56	.34	165
	F	15	.60	.90	.41	220
	M	15	-.47	-.41	-.54	76
	F	15	.40	.47	.34	138
	M	15	.49	.41	.58	71
	M	15	.76	1.24	.47	264
	M	27	.47	.44	.49	90
	F	15	.61	.62	.60	102
	F	15	.20	.32	.12	267
	M	15	.35	.32	.39	82
	M	15	.56	.67	.47	142
	M	15	.14	.10	.18	56
	F	15	.58	.64	.52	123
	F	15	.73	.80	.67	119
	F	15	.70	.63	.77	82
	M	15	.33	.31	.35	88
	F	15	.26	.24	.27	89
	F	15	.31	.31	.31	100
	M	15	-.05	-.09	-.02	450
	F	15	.74	1.05	.52	202
	F	15	.68	.79	.58	136
	F	15	.73	1.28	.40	320
	M	15	.58	.75	.45	167
	F	15	.66	.70	.62	113
	M	15	.43	.33	.57	58
	M	15	.62	.69	.41	207
	M	15	.16	.20	.13	154
	F	15	.22	.27	.17	159
	M	15	.42	.46	.38	121
	M	15	.53	.65	.43	151
	F	15	.27	.24	.30	80
	M	18	.37	.44	.32	138
	F	16	.52	.63	.45	140
Means	M	14	.03	.05	.02	250
Means	F	16	.26	.17	.40	42
	M	15	.78	1.10	.55	200
	M	15	.35	.34	.36	94

TABLE 29

Lag in Bones of Hand. German Females. Data of Pfitzner (Lewenz and Whiteley, Biometrika, 1)

N, 37-47; R, Right; L, Left; R and L with Subscript Number, as R_2, L_3, indicate Length of Fingers; m, Metacarpal; p, Phalanx, Proximal; m, Middle Phalanx; d, Distal Phalanx; l, $\frac{\Sigma}{N}$

x	y	r xy	r xl	r xy (Vx/Vy)	r xy (Vy/Vx)	Ratio of Lags
R_2	R_3	.96	.13	.89	1.04	84
	R_4	.95	.16	.85	1.06	82
	R_5	.90	.21	.72	1.12	65
R_3	R_4	.96	-.04	.93	.99	94
	R_5	.92	.13	.80	1.06	75
R_4	R_5	.93	.11	.83	1.04	79
L_2	L_3	.95	-.23	.97	.93	104

TABLE 29 (Cont..)

Lag in Bones of Hand

x	y	r xy	r xl	r xy (Vx/Vy)	r xy (Vy/Vx)	Ratio of Lags
	L_4	.94	.06	.87	1.02	85
	L_5	.90	-.11	.86	.95	91
L_3	L_4	.95	.15	.85	1.05	81
	L_5	.89	-.09	.83	.96	86
L_4	L_5	.89	-.29	.92	.86	107
Rm_1	Rp_1	.82	-.16	.85	.79	108
	Rd_1	.55	-.61	.86	.45	144
Rp_1	Rd_1	.56	-.57	.67	.51	131
Lm_1	Lp_1	.82	-.08	.72	.95	76
	Ld_1	.53	-.52	.55	.51	108
Lp_1	Ld_1	.54	-.62	.64	.45	142
Rm_2	p_2	.84	-.26	.82	.85	96
	m_2	.80	-.04	.66	.97	68
	d_2	.53	-.49	.54	.53	102
p_2	m_2	.83	-.00	.70	1.00	70
	d_2	.49	-.40	.43	.56	77
m_2	d_2	.52	-.52	.54	.50	108
Lm_2	p_2	.80	-.24	.75	.84	89
	m_2	.69	-.13	.54	.88	61
	d_2	.58	-.44	.48	.55	87
p_2	m_2	.86	.05	.72	1.03	70
	d_2	.50	-.49	.50	.51	98
m_2	d_2	.48	-.63	.57	.40	143
Rm_3	p_3	.81	-.13	.82	.80	103
	m_3	.74	-.11	.61	.91	67
	d_3	.70	-.02	.50	.97	52
p_3	m_3	.90	.22	.72	1.12	65
	d_3	.69	-.21	.49	.98	50
m_3	d_3	.68	-.26	.60	.77	78
Lm_3	p_3	.80	-.29	.78	.82	95
	m_3	.68	-.09	.51	.91	56
	d_3	.69	-.09	.51	.92	55
p_3	m_3	.84	.13	.64	1.09	57
	d_3	.57	-.23	.44	.74	59
m_3	d_3	.60	-.45	.60	.60	100
Rm_4	p_4	.81	-.17	.73	.89	82
	m_4	.80	.05	.62	1.04	60
	d_4	.70	-.12	.55	.89	62
p_4	m_4	.90	.12	.76	1.06	72
	d_4	.63	-.29	.54	.72	75
m_4	d_4	.67	-.43	.68	.65	105
Lm_4	p_4	.79	-.15	.78	.81	96
	m_4	.73	-.04	.59	.96	58
	d_4	.58	-.24	.49	.74	62
p_4	m_4	.84	.12	.66	1.09	59
	d_4	.62	-.43	.50	.78	64
m_4	d_4	.60	-.47	.61	.58	105
Rm_5	p_5	.81	-.17	.74	.89	83
	m_5	.63	-.01	.41	.92	41
	d_5	.51	-.32	.41	.64	64
p_5	m_5	.81	.18	.57	1.16	49
	d_5	.64	-.30	.56	.73	77
m_5	d_5	.43	-.67	.54	.35	154
Lm_5	p_5	.80	-.20	.74	.87	85
	m_5	.57	-.16	.41	.81	51
	d_5	.45	-.38	.37	.55	67
p_5	m_5	.68	-.10	.52	.90	58
	d_5	.46	-.43	.41	.52	79
m_5	d_5	.36	-.65	.42	.31	136
Rm_1	Rm_2	.81	-.54	.96	.64	141
	Rm_3	.82	-.58	1.01	.68	153
	Rm_4	.73	-.59	.90	.59	153
	Rm_5	.66	-.57	.78	.56	139
Rm_2	Rm_3	.94	-.28	.98	.91	108
	Rm_4	.91	-.30	.95	.88	108
	Rm_5	.86	-.26	.86	.86	100
Rm_3	Rm_4	.95	-.17	.95	.94	101
	Rm_5	.89	-.16	.85	.92	92
Rm_4	Rm_5	.93	-.07	.89	.97	92
Lm_1	Lm_2	.78	-.48	.88	.70	126
	Lm_3	.79	-.56	.95	.66	144
	Lm_4	.70	-.50	.79	.63	125
	Lm_5	.66	-.49	.72	.61	118
Lm_2	Lm_3	.94	-.37	1.01	.87	116
	Lm_4	.91	-.20	.90	.91	99
	Lm_5	.89	-.17	.86	.92	93
Lm_3	Lm_4	.93	.13	.86	1.00	86
	Lm_5	.88	-.04	.79	.98	81
Lm_4	Lm_5	.95	-.08	.92	.97	95
Rp_1	Rp_2	.84	-.46	.99	.75	125
	Rp_3	.82	-.55	.98	.68	144
	Rp_4	.80	-.42	.87	.74	118
	Rp_5	.85	-.33	.89	.82	109
Rp_2	Rp_3	.94	-.36	1.00	.87	126
	Rp_4	.89	-.15	.85	.93	91
	Rp_5	.89	-.07	.83	.96	86
Rp_3	Rp_4	.95	.16	.85	1.06	82
	Rp_5	.92	.13	.79	1.06	75
Rp_4	Rp_5	.92	-.11	.88	.95	93
Lp_1	Lp_2	.87	-.57	1.06	.72	147
	Lp_3	.86	-.70	1.17	.64	182
	Lp_4	.82	-.60	1.03	.68	151
	Lp_5	.78	-.51	.90	.67	134
Lp_2	Lp_3	.91	-.44	1.02	.82	124
	Lp_4	.88	-.31	.91	.85	107
	Lp_5	.86	-.18	.82	.90	91
Lp_3	Lp_4	.93	.00	.86	1.00	86
	Lp_5	.86	.01	.73	1.01	72
Lp_4	Lp_5	.91	-.03	.83	.99	84
Rm_2	m_3	.90	-.29	.93	.83	107
	m_4	.91	-.16	.89	.93	96
	m_5	.76	-.03	.59	.98	60
m_3	m_4	.94	-.02	.89	.99	90
	m_5	.75	-.00	.57	1.00	57
m_4	m_5	.84	-.08	.67	1.05	64
Lm_2	m_3	.92	-.25	.95	.90	106
	m_4	.93	-.09	.90	.96	94
	m_5	.82	-.08	.71	.95	75
m_3	m_4	.96	-.09	.91	1.02	89
	m_5	.76	-.13	.65	.90	72
m_4	m_5	.86	-.08	.77	.95	81
Rd_1	d_2	.60	-.29	.51	.71	72
	d_3	.63	-.14	.47	.85	55
	d_4	.73	-.12	.60	.90	67
	d_5	.68	-.16	.54	.85	64

LAG IN BODY DIMENSIONS

TABLE 29
(Cont.)

Lag in Bones of Hand

x	y	r xy	r xL	r xy (Vx/Vy)	r xy (Vy/Vx)	Ratio of Lags
d_2	d_3	.50	−.12	.70	.91	77
	d_4	.79	−.26	.79	.82	91
	d_5	.80	−.22	.75	.55	88
d_3	d_4	.66	−.42	.94	.79	119
	d_5	.77	−.43	.82	.72	114
d_4	d_5	.83	−.26	.81	.85	95
Ld_1	d_2	.70	−.19	.70	.70	100
	d_3	.74	−.19	.64	.85	75
	d_4	.75	−.13	.63	.89	71
	d_5	.59	−.31	.50	.69	72
d_2	d_3	.86	−.01	.74	.99	75
	d_4	.82	−.03	.68	.98	69
	d_5	.80	−.08	.68	.94	72
d_3	d_4	.92	−.12	.88	.95	93
	d_5	.75	−.13	.74	.76	97
d_4	d_5	.80	−.34	.82	.78	105

TABLE 30

Correlations and Lags in Weights
of 48-64 Left Hand Bones
(Pyle, KD, 7:109-113, 1935)

x	y	r xy	r xy (Vx/Vy)	r xy (Vy/Vx)	Ratio of Lags
Greater Multangular	Lesser Multangular	.88	.85	.91	93
Greater Multangular	Capitate	.87	.89	.85	105
Greater Multangular	Hamate	.79	.88	.71	124
Greater Multangular	Navicular	.76	.77	.75	103
Greater Multangular	Lunate	.76	.79	.73	108
Greater Multangular	Triquetral	.74	.73	.75	97
Lesser Multangular	Capitate	.89	.93	.85	109
Lesser Multangular	Hamate	.85	.97	.75	129
Lesser Multangular	Navicular	.84	.87	.81	107
Lesser Multangular	Lunate	.77	.83	.71	117
Lesser Multangular	Triquetral	.76	.78	.74	105
Hamate	Capitate	.89	.82	.97	84
Hamate	Navicular	.83	.76	.90	84
Navicular	Capitate	.85	.85	.85	100
Lunate	Capitate	.82	.80	.84	95
Lunate	Hamate	.82	.87	.77	113
Lunate	Navicular	.79	.77	.81	95
Lunate	Triquetral	.77	.73	.81	90
Triquetral	Capitate	.77	.78	.75	104
Triquetral	Hamate	.80	.89	.72	124
Triquetral	Navicular	.70	.71	.69	103
Pisiform	Greater Multangular	.50	.57	.44	130
Pisiform	Lesser Multangular	.43	.47	.39	120
Pisiform	Capitate	.53	.61	.46	133
Pisiform	Hamate	.56	.71	.44	161
Pisiform	Navicular	.47	.54	.41	132
Pisiform	Lunate	.48	.57	.40	142
Pisiform	Triquetral	.63	.69	.54	128
1st Metacarpal	2nd Metacarpal	.86	.86	.86	100
1st Metacarpal	3rd Metacarpal	.81	.80	.82	98
1st Metacarpal	4th Metacarpal	.80	.77	.83	93
1st Metacarpal	5th Metacarpal	.81	.78	.84	93
2nd Metacarpal	3rd Metacarpal	.90	.88	.92	96
2nd Metacarpal	4th Metacarpal	.89	.85	.93	91
2nd Metacarpal	5th Metacarpal	.90	.86	.94	91
3rd Metacarpal	4th Metacarpal	.92	.89	.95	94
3rd Metacarpal	5th Metacarpal	.93	.90	.96	94
4th Metacarpal	5th Metacarpal	.90	.90	.90	100
1st Proximal Phalanx	2nd Proximal Phalanx	.93	.92	.94	98
1st Proximal Phalanx	3rd Proximal Phalanx	.88	.84	.93	90
1st Proximal Phalanx	4th Proximal Phalanx	.84	.82	.86	95
1st Proximal Phalanx	5th Proximal Phalanx	.89	.86	.92	93
2nd Proximal Phalanx	3rd Proximal Phalanx	.93	.89	.97	92
2nd Proximal Phalanx	4th Proximal Phalanx	.95	.94	.96	98
2nd Proximal Phalanx	5th Proximal Phalanx	.90	.88	.92	96
3rd Proximal Phalanx	4th Proximal Phalanx	.95	.98	.92	106
3rd Proximal Phalanx	5th Proximal Phalanx	.93	.95	.91	104
4th Proximal Phalanx	5th Proximal Phalanx	.90	.89	.91	98
2nd Middle Phalanx	3rd Middle Phalanx	.92	.92	.92	100
2nd Middle Phalanx	4th Middle Phalanx	.86	.89	.83	107
2nd Middle Phalanx	5th Middle Phalanx	.89	.88	.90	98
3rd Middle Phalanx	4th Middle Phalanx	.91	.94	.88	107
3rd Middle Phalanx	5th Middle Phalanx	.90	.89	.91	98
4th Middle Phalanx	5th Middle Phalanx	.94	.90	.98	92
1st Distal Phalanx	2nd Distal Phalanx	.81	.72	.91	79
1st Distal Phalanx	3rd Distal Phalanx	.88	.77	1.00	77
1st Distal Phalanx	4th Distal Phalanx	.86	.83	.89	93

TABLE 30
(Cont.)

x	y	r xy	r xy (Vx/Vy)	r xy (Vy/Vx)	Ratio of Lags
1st Distal Phalanx	5th Distal Phalanx	.88	1.83	.42	436
2nd Distal Phalanx	3rd Distal Phalanx	.86	.85	.87	98
2nd Distal Phalanx	4th Distal Phalanx	.70	.77	.64	120
2nd Distal Phalanx	5th Distal Phalanx	.81	1.93	.34	568
3rd Distal Phalanx	4th Distal Phalanx	.80	.88	.73	120
3rd Distal Phalanx	5th Distal Phalanx	.83	1.97	.35	563
4th Distal Phalanx	5th Distal Phalanx	.84	1.80	.39	460

TABLE 31

x, Head Circumference

y	Germans					
	1300 Male			1000 Female		
	r xy (Vx/Vy)	r xy (Vy/Vx)	Ratio of Lags	r xy (Vx/Vy)	r xy (Vy/Vx)	Ratio of Lags
Head Height	.18	.59	30	.19	.59	32
Stem Length	.17	.44	39	.17	.42	40
Arm Length	.11	.30	37	.14	.40	35
Leg Length	.06	.17	35	.04	.12	33
Stature, Means of 32 Groups of French Soldiers	.24	.12	21 (r xy = .52)			

TABLE 32

x, Trunk Length
y, Leg Length

Group	Sex	N	r xy	r xy (Vx/Vy)	r xy (Vy/Vx)	Ratio of Lags
North Sweden	M	4795	.16	.17	.19	92
West Sweden	M	13222	.17	.17	.17	97
East Sweden	M	15497	.18	.18	.18	100
South Sweden	M	8714	.18	.18	.18	102
Cities of Sweden	M	4755	.20	.19	.21	88
Total Sweden	M	47387	.18	.18	.18	96

x, Arm Length
y, Trunk Length

Group	Sex	N	r xy	r xy (Vx/Vy)	r xy (Vy/Vx)	Ratio of Lags
North Sweden	M	4795	.33	.35	.31	115
West Sweden	M	13222	.31	.34	.29	117
East Sweden	M	15497	.31	.34	.28	119
South Sweden	M	8714	.30	.33	.27	123
Cities of Sweden	M	4755	.31	.33	.30	110
Total Sweden	M	47387	.31	.34	.29	117
Germans	M	549	--	.43	.32	134
Germans	F	442	--	.36	.28	129

x, Arm Length
y, Leg Length

Group	Sex	N	r xy	r xy (Vx/Vy)	r xy (Vy/Vx)	Ratio of Lags
North Sweden	M	4795	.80	.71	.90	79
West Sweden	M	13222	.79	.72	.87	83
East Sweden	M	15497	.79	.73	.86	85
South Sweden	M	8714	.78	.71	.86	83
Cities of Sweden	M	4755	.80	.72	.89	81
Total Sweden	M	47387	.80	.73	.88	83
Germans	M	1285	--	.60	.79	76
Germans	F	1017	--	.50	.67	75

TABLE 33

x, Shoulder Breadth
y, Pelvic Breadth

North Sweden	M	4795	.40	.33	.48	69
West Sweden	M	13222	.39	.31	.49	64
East Sweden	M	15497	.37	.29	.47	62
South Sweden	M	8714	.40	.32	.49	66
Cities of Sweden	M	4755	.37	.31	.44	71
Total	M	47387	.38	.30	.48	64
New York Children						
Age 3 Years	M	18	.39	.37	.41	90
Age 4 Years	M	20	.75	1.16	.49	230
Age 5 Years	M	18	.74	.97	.56	173
Age 6 Years	M	19	.69	1.00	.48	208
Age 7 Years	M	22	.64	.80	.51	156
Age 8 Years	M	14	.70	.71	.69	102
Age 3 Years	F	21	.61	.63	.59	106
Age 4 Years	F	22	.58	.61	.55	110
Age 5 Years	F	20	.56	.54	.58	93
Age 6 Years	F	25	.80	.89	.72	123
Age 7 Years	F	22	.54	.52	.56	93
Age 8 Years	F	13	.48	.42	.55	76
California Children						
Age 1 Month	M & F	47-59	.62	.40	.98	41
Age 3 Months	M & F	47-59	.59	.34	1.01	34
Age 6 Months	M & F	47-59	.47	.34	.65	52
Age 9 Months	M & F	47-59	.61	.49	.77	64
Age 12 Months	M & F	47-59	.47	.36	.60	60
Age 15 Months	M & F	47-59	.64	.51	.79	64
Age 18 Months	M & F	47-59	.70	.51	.95	54
Age 24 Months	M & F	47-59	.61	.54	.69	78
Age 36 Months	M & F	47-59	.65	.46	.90	51

LAG IN BODY DIMENSIONS

TABLE 34

x, Trunk Length
y, Pelvic Breadth

Group	Sex	N	r xy	r xy (Vx/Vy)	r xy/(Vy/Vx)	Ratio of Lags
North Sweden	M	4795	.32	.29	.35	83
West Sweden	M	13222	.31	.27	.36	74
East Sweden	M	15497	.29	.26	.33	77
South Sweden	M	8714	.32	.29	.36	79
Cities of Sweden	M	4755	.31	.27	.36	76
Total Sweden	M	47387	.30	.26	.34	76
California Children						
Age, 1 Months	M & F	47-59	.64	.39	1.06	37
Age, 3 Months	M & F	47-59	.58	.27	1.23	22
Age, 6 Months	M & F	47-59	.39	.19	.81	23
Age, 9 Months	M & F	47-59	.40	.22	.73	30
Age, 12 Months	M & F	47-59	.64	.39	1.04	37
Age, 15 Months	M & F	47-59	.72	.42	1.21	35
Age, 18 Months	M & F	47-59	.67	.41	1.09	38
Age, 24 Months	M & F	47-59	.58	.37	.91	41
Age, 36 Months	M & F	47-59	.60	.48	.76	63

TABLE 35

x, Trunk Length
y, Shoulder Breadth

Group	Sex	N	r xy	r xy (Vx/Vy)	r xy/(Vy/Vx)	Ratio of Lags
North Sweden	M	4795	.26	.29	.24	121
West Sweden	M	13222	.24	.30	.26	117
East Sweden	M	15497	.26	.31	.25	123
South Sweden	M	8714	.28	.31	.26	121
Cities of Sweden	M	4755	.23	.24	.22	106
Total Sweden	M	47387	.27	.29	.25	117
California Children						
Age, 1 Months	M&F	47-59	.45	.43	.48	90
Age, 3 Months	M&F	47-59	.52	.47	.73	64
Age, 6 Months	M&F	47-59	.50	.33	.74	45
Age, 9 Months	M&F	47-59	.50	.34	.71	48
Age, 12 Months	M&F	47-59	.54	.43	.69	62
Age, 15 Months	M&F	47-59	.83	.46	.85	54
Age, 18 Months	M&F	47-59	.49	.42	.58	72
Age, 24 Months	M&F	47-59	.51	.37	.70	53
Age, 36 Months	M&F	47-59	.53	.59	.48	123

TABLE 36

x, Stature
y, Arm Length

Group	Sex	N	r xy	r xy (Vx/Vy)	r xy/(Vy/Vx)	Ratio of Lags
English Criminals	M	3000	.80	.71	.90	79
Egyptian (Cairo)	M	802	.80	.63	1.03	61
English (Fathers)	M	1079	.64	.49	.84	58
English (Sons)	M	1401	.69	.51	.92	55
English (Mothers)	F	1079	.60	.44	.81	54
English (Daughters)	F	1401	.72	.54	.95	57
French Cadavers	M	44	.54	.78	.90	87
French Cadavers Humerus	M	44	.77	.72	.83	87
French Cadavers Ulna	M	44	.84	.79	.89	89
French Cadavers Radius	M	44	.80	.64	1.00	64
Germans	M	1273	--	.53	--	--
Germans	F	1004	--	.45	--	--
New York Children						
Age, 2 Years	M	19	.76	.58	1.60	36
Age, 3 Years	M	29	.74	.61	.89	69
Age, 4 Years	M	33	.66	.52	1.43	36
Age, 5 Years	M	32	.60	.51	1.25	41
Age, 6 Years	M	24	.81	.62	1.05	59
Age, 7 Years	M	23	.88	.52	1.43	36
Age, 8 Years	M	16	.91	.58	1.42	41
Age, 2 Years	F	21	.72	.36	1.44	25
Age, 3 Years	F	30	.57	.46	1.64	28
Age, 4 Years	F	34	.88	.51	1.52	33
Age, 5 Years	F	34	.72	.53	.99	54
Age, 6 Years	F	28	.83	.41	1.69	24
Age, 7 Years	F	22	.86	.60	1.23	49
Age, 8 Years	F	15	.87	.54	1.40	39

TABLE 37

x, Stature
y, Arm Length $1, \frac{y}{x}$

Group	Sex	N	r xl	Group	Sex	N	r xl
East Holstein	M	260	-.03	French (Total)	M	50	.09
East Holstein	F	310	-.02	French (Humerus)		50	.17
English Criminals	M	3000	-.15	French (Radius)		50	.01
Ramah Indians	M	25	.21	French Cadavers (Total)		44	-.16
Chinese (Total Arm)	M	48	-.25	French Cadavers (Humerus)		44	-.25
Chinese (Humerus)	M	48	-.28	French Cadavers (Ulna)		44	-.19
Chinese (Radius)	M	48	-.13	French Cadavers (Radius		44	.001

x, Stature
y, Leg Length $1, \frac{y}{x}$

Group	Sex	N	r xl	Group	Sex	N	r xl
French	M	50	.29	Chinese	M	48	.10
French (Tibia)	M	50	.16	Chinese (Tibia)		48	.19
French (Femur)	M	50	.32	Chinese (Femur)		48	.02
French Cadavers	M	44	-.25	French Cadavers (Tibia)			-.18
French Cadavers (Femur)	M	44	-.10	French Cadavers (Fibula)			-.11
Oxford, 18 Yrs.	M	129	.42	Oxford, 21 Yrs.	M	137	.48
Oxford, 19 Yrs.	M	330	.35	Oxford, 22 Yrs.		95	.40
Oxford, 20 Yrs.	M	209	.39				

TABLE 38

x, Stature
y, Chest Circumference $1, \frac{y}{x}$

Group	Sex	N	r xy	r xy (Vx/Vy)	r xy (Vy/Vx)	Ratio of Lags
London Police	M	100	.04	.02	.07	29
Westminster School, 12-18 Years	M	279	.78	.60	1.02	59
London School, 5-13 Years	M	215	.89	1.14	.69	160
Manchester School, 11 Years	M	29	.82	.17	.28	61
Manchester School, 12 Years	M	112	.65	.63	.68	93
Manchester School, 13 Years	M	173	.67	.60	.74	81
Manchester School, 14 Years	M	255	.65	.55	.76	72
Manchester School, 15 Years	M	263	.69	.52	.91	57
Manchester School, 16 Years	M	173	.65	.50	.85	59
Manchester School, 17 Years	M	80	.51	.33	.79	42
Manchester School, 18 Years	M	25	.37	.32	.43	74
Manchester School, 11-18 Years	M	1110	.84	.69	1.03	67
California						
1, Month	M&F	47-59	.50	.43	.57	75
3, Months	M&F	47-59	.55	.44	.67	66
6, Months	M&F	47-59	.54	.41	.71	58
9, Months	M&F	47-59	.65	.58	.73	79
12, Months	M&F	47-59	.66	.48	.73	66
15, Months	M&F	47-59	.63	.51	.78	65
18, Months	M&F	47-59	.53	.44	.63	70
24, Months	M&F	47-59	.69	.52	.87	60
36, Months	M&F	47-59	.55	.50	.60	83
U. S. Soldiers	M	868,445	.23	.15	.35	43
				r xl		
English Air Force Candidates	M	1236	.34	-.32		
English Air Force Candidates	M	950	.34	-.33		
London Police	M	100	.04	-.88		

TABLE 39

x, Stature
y, Foot Length

Group	Sex	N	r xy	r xy (Vx/Vy)	r xy (Vy/Vx)	Ratio of Lags
English Criminals	M	3000	.74	.62	.87	71
Egyptians, Cairo	M	802	.72	.54	.95	57
y, Finger Length						
English Criminals	M	3000	.66	.54	.81	67
Egyptians, Cairo	M	802	.66	.44	.99	44
Germans (Ray III)	M&F	249	--	.65	.84	77
y, Foot Length			kx	bl	r xl	
Ramah Indians	M	25	33.621	.002x	.25	
English Criminals	M	3000	--	--	-.16	
y, Foot Breadth						
Ramah Indians	M	25	-4.161	-.004x	-.13	
y, Hand Length						
Ramah Indians	M	25	41.451	.001x	.24	

TABLE 40

x, Stature
y, Head Breadth

Group		Sex	N	r xy	r xy (Vx/Vy)	r xy (Vy/Vx)	Ratio of Lags
Children, Age 6-17 Yrs							
Worcester,	6 Years	M	105	.20	.30	.13	231
	7 Years	M	142	.27	.35	.20	175
	8 Years	M	126	.19	.25	.15	167
	9 Years	M	167	.23	.30	.17	176
	10 Years	M	157	.31	.43	.22	195
	11 Years	M	151	.29	.38	.22	173
	12 Years	M	177	.24	.28	.21	133
	13 Years	M	168	.28	.45	.18	250
	14 Years	M	159	.11	.18	.06	300
	15 Years	M	152	.33	.55	.20	275
	16 Years	M	56	.17	.21	.14	150
	17 Years	M	49	.25	.25	.25	100
	6 Years	F	84	.34	.56	.21	267
	7 Years	F	103	.17	.28	.10	280
	8 Years	F	105	.12	.19	.08	238
	9 Years	F	118	.17	.21	.14	150
	10 Years	F	160	.18	.28	.12	233
	11 Years	F	152	.12	.20	.07	280
	12 Years	F	165	.44	.67	.29	231
	13 Years	F	142	.24	.32	.18	178
	14 Years	F	115	.42	.53	.33	161
	15 Years	F	109	.09	.10	.08	125
	16 Years	F	91	.15	.17	.13	131
	17 Years	F	69	.06	.07	.05	140
ADULTS							
Aberdeen, Normal		M	787	.22	.24	.19	129
Aberdeen, Insane		M	297	.26	.34	.19	179
Banff, Normal		M	105	.16	.16	.16	97
Banff, Insane		M	84	.12	.15	.10	156
Scottish Soldiers		M	2687	.19	.20	.18	110
Scottish, Insane		M	4381	.20	.24	.17	147
83 Ethnic Groups		M&F		-.04	-.03	-.06	50
English Criminals		M	3000	.18	.21	.16	131
Oxford Students, 18 Years		M	129	.05	.05	.05	100
Oxford Students, 19 Years		M	330	.17	.19	.17	112
Oxford Students, 20 Years		M	209	.19	.21	.17	124

LAG IN BODY DIMENSIONS

TABLE 40
(Cont.)

x, Stature
y, Head Breadth

Group	Sex	N	r xy	r xy (Vx/Vy)	r xy (Vy/Vx)	Ratio of Lags
ADULTS						
Oxford Students, 21 Years	M	137	.10	.13	.08	162
Oxford Students, 22 Years	M	95	.17	.18	.16	112
Cambridge Students	M	1000	.15	.17	.14	121

TABLE 41

x, Stature
y, Head Height

Aberdeen, Normal	M	787	.25	.21	.29	72
Aberdeen, Insane	M	297	.17	.13	.15	125
Banff, Normal	M	105	.08	.07	.09	72
Banff, Insane	M	84	.21	.20	.22	93
Scottish Soldiers	M	2687	.26	.23	.29	78
Scottish, Insane	M	4361	.25	.25	.22	112
Oxford Students, 18 Years	M	129	.09	.07	.12	58
Oxford Students, 19 Years	M	330	.28	.23	.33	70
Oxford Students, 20 Years	M	209	.31	.27	.35	77
Oxford Students, 21 Years	M	137	.32	.33	.31	106
Oxford Students, 22 Years	M	95	.42	.36	.49	73
53 Ethnic Groups			.10	.04	.24	167

TABLE 42

x, Stature
y, Head Length L, $\frac{Y}{X}$

83 Ethnic Groups	M&F		.10	.13	.07	186
Aberdeen, Normal	M	787	.34	.41	.28	150
Aberdeen, Insane	M	297	.31	.42	.23	179
Banff, Normal	M	105	.31	.32	.31	106
Scottish Soldiers	M	2687	.27	.29	.24	121
Scottish, Insane	M	4361	.33	.42	.26	166
English Criminals	M	3000	.34	.42	.28	150
North Sweden, 21 Yrs.	M	4795	.25	.28	.23	121
West Sweden, 21 Yrs.	M	13222	.24	.26	.22	114
East Sweden, 21 Yrs.	M	15497	.25	.27	.24	113
South Sweden, 21 Yrs.	M	8714	.27	.30	.25	119
Cities Sweden, 21 Yrs.	M	4755	.28	.31	.25	120
Total Sweden, 21 Yrs.	M	47387	.25	.27	.23	116
OXFORD STUDENTS						
18 Years	M	129	.22	.23	.21	110
19 Years	M	330	.31	.36	.27	133
20 Years	M	209	.35	.39	.31	126
21 Years	M	137	.36	.43	.30	143
22 Years	M	95	.33	.35	.28	139
Cambridge Students	M	1000	.28	.33	.24	138
			bx	by	r xl	
Swedish, 25 Groups	M		-.27y	-.20x	-.50	
OXFORD STUDENTS						
18 Years	M	129	--	--	-.64	
19 Years	M	330	--	--	-.66	
20 Years	M	209	--	--	-.63	
21 Years	M	137	--	--	-.67	
22 Years	M	95	--	--	-.68	
Cambridge Students	M	1000	--	--	-.68	
English Criminals	M	3000	--	--	-.69	
WORCESTER						
6 Years	M	105	.30	.43	.21	205
7 Years	M	142	.36	.43	.30	143
8 Years	M	120	.44	.61	.32	191
9 Years	M	167	.41	.51	.33	154
10 Years	M	157	.31	.46	.21	219
11 Years	M	151	.39	.53	.29	183
12 Years	M	177	.36	.49	.27	181
13 Years	M	168	.32	.48	.21	229
14 Years	M	154	.39	.62	.25	248
15 Years	M	152	.42	.66	.27	244
16 Years	M	96	.31	.36	.26	138
17 Years	M	49	.19	.20	.18	111
6 Years	F	84	.21	.33	.13	254
7 Years	F	101	.37	.51	.27	189
8 Years	F	105	.32	.45	.23	196
9 Years	F	118	.38	.45	.32	141
10 Years	F	160	.36	.53	.24	221
11 Years	F	152	.37	.69	.20	345
12 Years	F	165	.38	.63	.23	274
13 Years	F	142	.40	.49	.33	148
14 Years	F	115	.37	.49	.28	175
15 Years	F	109	.14	.17	.12	142
16 Years	F	91	.27	.33	.22	150
17 Years	F	89	.32	.35	.29	121

TABLE 43

x, Stature
y, Various Head Measurements

y, Face Breadth						
English Criminals	M	3000	.34	.36	.33	109
58 Ethnic Groups	M&F		-.17	-.09	-.32	28
y, Face Length						
43 Russian Groups	M&F		-.06	-.04	-.10	50
y, Head Height						
Germans	M	1685	--	--	.27	--
Germans	F	1359	--	--	.13	--

TABLE 43
(Cont.)

x, Stature
y, Various Head Measurements

Group	Sex	N	r xy	r xy (Vx/Vy)	r xy (Vy/Vx)	Ratio of Lags
y, Head Circumference						
Germans	M	1679	--	.34	.21	162
Germans	F	1354	--	.30	.15	200
Germans	M	1482	--	--	.21	--
Germans	F	1162	--	--	.14	--
Germans 20-40 Years	M	414	--	--	.19	--
Germans 20-40 Years	F	346	--	--	.12	--
Germans 20-40 Years	M	1679	--	--	.04	--
Germans	F	1354	--	--	.01	--
y, Cranial Capacity						
Norwegians, 12 Groups	M&F		.30	.21	.42	50
Scandinavians, 10 Groups	M&F		.56	.29	1.11	26

TABLE 44

x, Stature
y, Leg Length (Tibiale to Heel)

NEW YORK CHILDREN						
3 Years	M	14	.88	.79	.96	81
4 Years	M	16	.85	.71	1.02	69
5 Years	M	26	.91	.63	1.32	47
6 Years	M	18	.92	.75	1.14	65
7 Years	M	22	.76	.65	.89	73
8 Years	M	14	.91	.77	1.07	71
3 Years	F	11	.86	.83	.90	92
4 Years	F	21	.82	.62	1.08	57
5 Years	F	20	.79	.70	.89	79
6 Years	F	23	.58	.38	.89	43
7 Years	F	22	.53	.43	.65	66
8 Years	F	12	.75	.68	.83	82

TABLE 45

x, Stature
y, Leg Length

North Sweden, 21 Yrs.	M	4795	.88	.64	1.21	53
West Sweden, 21 Yrs.	M	13222	.88	.65	1.20	54
East Sweden, 21 Yrs.	M	15497	.87	.64	1.18	54
South Sweden, 21 Yrs.	M	8714	.87	.64	1.17	55
Cities Sweden 21 Yrs.	M	4755	.86	.63	1.17	54
Total Sweden, 21 Yrs.	M	47387	.87	.64	1.18	55
New Guinea	M	38	.92	.65	1.32	49
French Cadavers	M	44	.88	.88	.88	100
French Cadavers, Femur	M	44	.85	.76	.94	81
Tibia	M	44	.89	.86	.92	93
Fibula	M	44	.88	.82	.95	86
OXFORD STUDENTS						
18 Years	M	129	.87	.56	1.36	41
19 Years	M	330	.86	.58	1.28	45
20 Years	M	209	.89	.62	1.28	48
21 Years	M	137	.91	.62	1.33	47
22 Years	M	95	.91	.66	1.25	53
18 Years, Thigh	M	129	.80	.39	1.65	24
19 Years, Thigh	M	330	.74	.41	1.32	31
20 Years, Thigh	M	209	.82	.49	1.37	36
21 Years, Thigh	M	137	.82	.50	1.34	37
22 Years, Thigh	M	95	.83	.52	1.32	39

TABLE 46

x, Stature
y, Pelvic Breadth

North Sweden	M	4795	.51	.35	.74	48
West Sweden	M	13222	.52	.34	.80	42
East Sweden	M	15497	.52	.34	.81	42
South Sweden	M	8714	.52	.34	.80	43
Cities, Sweden	M	4755	.53	.36	.79	45
Total, Sweden	M	47387	.52	.34	.79	43
NEW YORK CHILDREN						
3 Years	M	19	.55	.56	.54	103
4 Years	M	21	.75	.70	.83	84
5 Years	M	24	.66	.63	.72	85
6 Years	M	18	.77	.86	.69	125
7 Years	M	22	.74	.61	.89	69
8 Years	M	14	.84	.73	.97	75
3 Years	F	20	.46	.44	.48	92
4 Years	F	22	.64	.49	.83	59
5 Years	F	20	.55	.49	.62	79
6 Years	F	24	.67	.40	1.12	36
7 Years	F	23	.69	.58	.82	71
8 Years	F	13	.70	.52	.93	55
CALIFORNIA CHILDREN						
1 Months	M&F	47-59	.60	.32	1.11	29
3 Months	M&F	47-59	.49	.23	1.04	22
6 Months	M&F	47-59	.34	.16	.70	23
9 Months	M&F	47-59	.49	.24	.98	24
12 Months	M&F	47-59	.65	.36	1.18	30
15 Months	M&F	47-59	.66	.37	1.17	32
18 Months	M&F	47-59	.64	.39	1.04	37
24 Months	M&F	47-59	.67	.40	1.11	36
36 Months	M&F	47-59	.73	.57	.94	61

LAG IN BODY DIMENSIONS

TABLE 47

x, Stature
y, Shoulder Breadth

Group	Sex	N	r xy	r xy (Vx/Vy)	r xy (Vy/Vx)	Ratio of Lags
North Sweden	M	4795	.46	.38	.55	69
West Sweden	M	13222	.47	.38	.56	65
East Sweden	M	15497	.48	.39	.59	67
South Sweden	M	8714	.46	.37	.57	65
Cities of Sweden	M	4755	.46	.37	.57	65
Total of Sweden	M	47387	.47	.38	.54	66
NEW YORK CHILDREN						
3 Years	M	21	.73	.76	.66	115
4 Years	M	21	.86	.52	1.43	37
5 Years	M	21	.90	.63	1.29	48
6 Years	M	19	.93	.72	1.21	59
7 Years	M	22	.87	.58	1.30	45
8 Years	M	19	.79	.67	.93	72
3 Years	F	21	.53	.49	.58	84
4 Years	F	20	.61	.45	.84	54
5 Years	F	19	.51	.47	.55	85
6 Years	F	25	.66	.36	1.20	30
7 Years	F	22	.74	.64	.85	75
8 Years	F	13	.56	.48	.66	73
CALIFORNIA CHILDREN						
1 Months	M&F	47-59	.59	.49	.70	70
3 Months	M&F	47-59	.67	.54	.84	64
6 Months	M&F	47-59	.64	.42	.97	43
9 Months	M&F	47-59	.56	.35	.89	39
12 Months	M&F	47-59	.54	.38	.76	50
15 Months	M&F	47-59	.57	.40	.81	49
18 Months	M&F	47-59	.57	.48	.68	70
24 Months	M&F	47-59	.66	.45	.95	47
36 Months	M&F	47-59	.50	.54	.46	117

TABLE 48

x, Stature
y, Stem Length, 1, 2

Group	Sex	N	r xy	r xy (Vx/Vy)	r xy (Vy/Vx)	Ratio of Lags
U. S. Soldiers	M	868445	.66	.66	.66	100
North Sweden	M	4795	.57	.43	.75	57
West Sweden	M	13222	.58	.43	.77	56
East Sweden	M	15497	.59	.44	.80	54
South Sweden	M	8714	.59	.43	.80	54
Cities of Sweden	M	4755	.47	.37	.60	61
Total Sweden	M	47387	.50	.38	.67	56
French Cadavers	M	44	.95	.86	1.06	81
London Police	M	100	.61	.52	.72	72
Amsterdam Students	M	116	.73	.48	1.11	43
Germans	F	1036	--	.50	--	--
Germans	M	1325	--	.60	--	--

Group	Sex	N	[illegible]	[illegible]	r xl
U. S. Soldiers, W.	M	96239	-52.45l	-.02x	-.93
U. S. Soldiers, N.	M	6433	-63.44l	-.01x	-.97
Nebraska Students	F	1500	- 9.40l	-.10x	-.97
English Air Force Candidates	M	1236	---	---	-.46
English Air Forces Candidates	M	950	---	---	-.46
Holstein	M	260	---	---	-.21
Holstein	F	310	---	---	-.27
Russians, 43 Groups Means	M&F		- .06l	-.04x	-.24
London Police	M	100	---	---	-.58
Negroes, U. S.	M	20	- 3.06l	-.08x	-.51
Ramah Indians	M	25	- 8.17l	-.005x	-.20
Winnipeg Indians	M	25	---	-.05x	---
Little Grand Rapids Indians	M	41	---	-.06x	---
Berens River Indians	M	43	---	-.12x	---
Grand Rapids Indians	M	12	---	-.15x	---
Blood Vein Indians	M	15	---	-.04x	---
Poplar River Indians	M	27	---	-.11x	---

Group	Sex	N	r xy	r xy (Vx/Vy)	r xy (Vy/Vx)	Ratio of Lags
CALIFORNIA CHILDREN						
1 Months	M&F		.74	.65	.84	77
3 Months	M&F		.78	.78	.78	100
6 Months	M&F		.81	.79	.83	95
9 Months	M&F		.84	.78	.92	85
12 Months	M&F		.88	.78	.99	79
15 Months	M&F		.88	.84	.93	90
18 Months	M&F		.80	.80	.80	100
24 Months	M&F		.86	.80	.91	88
36 Months	M&F		.79	.78	.81	96
NEW YORK CHILDREN						
3 Years	M	15	.79	.73	.85	86
4 Years	M	15	.68	.59	.78	76
5 Years	M	23	.71	.66	.76	87
6 Years	M	19	.26	.31	.21	148
7 Years	M	21	.53	.41	.68	60
8 Years	M	14	.66	.74	.59	125
3 Years	F	11	.51	.70	.37	189
4 Years	F	20	.83	.66	1.05	63
5 Years	F	19	.53	.59	.47	126
6 Years	F	25	.50	.35	.71	49
7 Years	F	21	.80	.78	.82	95
8 Years	F	13	.73	.72	.74	97
MANCHESTER (England) GRAMMAR SCHOOL						
11 Years	M	29	.49	.44	.54	81
12 Years	M	112	.85	.80	.91	88
13 Years	M	173	.88	.79	.98	81
14 Years	M	255	.89	.87	.90	97
15 Years	M	263	.82	.84	.81	104
16 Years	M	173	.85	.91	.80	114
17 Years	M	80	.81	.89	.74	120
18 Years	M	25	.82	.84	.80	105
LONDON SCHOOL						
5-13 Years	M	815	.94	.69	1.29	53

TABLE 48
(Cont.)

x, Stature
y, Stem Length

Group	Sex	N	r xy	r xy (Vx/Vy)	r xy (Vy/Vx)	Ratio of Lags
WESTMINSTER SCHOOL						
12-18 Years	M	279	.92	.82	1.03	80
WORCESTER CHILDREN						
6 Years	M	105	.78	.87	.70	124
7 Years	M	142	.81	.79	.84	94
8 Years	M	120	.83	.88	.78	113
9 Years	M	167	.79	.77	.81	95
10 Years	M	157	.80	.82	.78	105
11 Years	M	151	.86	.81	.94	86
12 Years	M	177	.88	.84	.92	91
13 Years	M	163	.90	.93	.87	107
14 Years	M	154	.92	.96	.88	109
15 Years	M	152	.85	.81	.89	91
16 Years	M	56	.79	.77	.81	95
17 Years	M	49	.77	.69	.87	79
6 Years	F	84	.67	.64	.70	91
7 Years	F	101	.74	.78	.70	111
8 Years	F	105	.81	.82	.80	102
9 Years	F	118	.81	.83	.79	105
10 Years	F	160	.84	.85	.83	102
11 Years	F	152	.83	.95	.73	130
12 Years	F	165	.84	.86	.82	105
13 Years	F	142	.80	.69	.93	74
14 Years	F	115	.85	.81	.89	91
15 Years	F	109	.81	.71	.92	77
16 Years	F	91	.71	.79	.64	123
17 Years	F	69	.71	.64	.79	81

TABLE 49

x, Stature 1, 2
y, Span

Group	Sex	N	r xy	r xl	r xy (Vx/Vy)	r xy (Vy/Vx)	Ratio of Lags
English, Fathers	M	1079	.78	-.12	.67	.91	74
English, Mothers	F	1079	.76	-.11	.63	.91	69
English, Sons	M	1401	.80	-.12	.70	.92	76
English Daughters	F	1401	.83	-.07	.72	.95	76
Alisor, Armenia	M	22	.75	.09	.52	1.09	87
Kashkoumouks, Caucasus	M	13	.80	.16	.57	1.13	50
Probstei, East Holstein	M	260	--	-.14	--	--	
Probstei, East Holstein	F	310	--	-.14	--	--	

TABLE 50

Lag in Traits of Sioux Indians
(Sullivan, 1925)

x, Stature
y, Sitting Height

Group	Sex	N	r xy	r xy (Vx/Vy)	r xy (Vy/Vx)	Ratio of Lags
Pure Sioux	M	536	.63	.51	.74	68
Pure Sioux	F	157	.54	.42	.70	60
Half-blood Sioux	M	77	.65	.52	.81	64
x, Stature y, Width of Shoulder						
Pure Sioux	M	534	.35	.23	.53	44
Pure Sioux	F	157	.43	.24	.77	31
Half-blood Sioux	M	77	.48	.39	.59	66
x, Stature y, Arm Reach						
Pure Sioux	M	531	.81	.68	.96	71
Pure Sioux	F	157	.83	.72	.96	74
Half-blood Sioux	M	77	.85	.87	.83	105
x, Stature y, Length of Arm						
Pure Sioux	M	532	.70	.49	.99	50
Pure Sioux	F	157	.67	.44	1.03	43
Half-blood Sioux	M	77	.76	.70	.82	85
x, Head Length y, Width of Head						
Pure Sioux	M	538	.27	.25	.30	83
Pure Sioux	F	156	.38	.32	.45	72
Half-blood Sioux	M	77	.54	.61	.48	126
x, Width of Head y, Width of Face						
Pure Sioux	M	538	.55	.52	.58	90
Pure Sioux	F	156	.49	.44	.54	82
Half-blood Sioux	M	77	.51	.43	.60	72
x, Height (Nasion to Chin) y, Width of Face						
Pure Sioux	M	534	.16	.22	.11	196
Pure Sioux	F	157	.31	.46	.21	222
Half-blood Sioux	M	77	.08	.11	.06	185
x, Nose Height y, Width of Nose						
Pure Sioux	M	536	.05	.04	.06	70
Pure Sioux	F	157	-.08	-.06	-.10	66
Half-blood	M	77	.02	.02	.02	64

SUMMARY OF LAGS

TABLE 51A

Lag in Head Dimensions. Means of Series

S, Skulls
L, Living
N, Number of Series. Adults Unless Otherwise Indicated

No. M	No. F	x	y	I	Material	Age	kx	kl	r xl
7		Ear Height	Thickness Lips	y/x					-.28
5		Face Breadth	Face Height	y/x	L		-.35l	-.47x	-.26
4		Face Breadth	Face Height	y/x	S		-.61l	-.30x	-.36
4		Face Breadth	Head Breadth	y/x	S		.62l	.19x	-.48
8		Foramen Mag. Length	Foramen Breadth	y/x	S				-.61
	2	Foramen Mag. Length	Foramen Breadth	y/x	S				-.60
5		Head Breadth	Head Length	x/y	S		.72l	.48x	.64
	2	Head Breadth	Head Length	x/y	S			.54x	.72
21		Head Length	Head Breadth	y/x	L		-1.00l	-.33x	-.55
	3	Head Length	Head Breadth	y/x	L		-1.32l	-.26x	-.56
28		Head Length	Head Breadth	y/x	S		-1.01l	-.41x	-.56
	16	Head Length	Head Breadth	y/x	S		-.86l	-.53x	-.62
12		Head Length	Head Breadth	y/x	L	6-17			-.63
	12	Head Length	Head Breadth	y/x	L	6-17			-.60
5		Head Length	Head Height	y/x	S		-.52l	-.78x	-.58
	3	Head Length	Head Height	y/x	S		-.45l	-.83x	-.51
20		Nasal Height	Nasal Breadth	y/x	S		-.35l	-.79x	-.47
	12	Nasal Height	Nasal Breadth	y/x	S		-.37l	-.88x	-.50
11		Nasal Height	Nasal Breadth	y/x	L		-.26l	-1.26x	-.52
7		Nose Breadth	Interpupillary Dist.	y/x	L				-.32
7		Nose Breadth	Thickness Lips	y/x	L				-.23
7		Nose Breadth	Ear Height	y/x	L				-.49
9		Orbital Breadth	Orbital Height	y/x	L		-.20l	-1.18x	-.45
	6	Orbital Breadth	Orbital Height	y/x	L		-.11l	-.76x	-.34
6		Palate Length	Palate Breadth	y/x	L		-.39l	-1.91x	-.70
	2	Palate Length	Palate Breadth	y/x	L				-.50

TABLE 51B

Lag in Head Dimensions

No. M	No. F	x	y	Material	Age	r xy (Vx/Vy)	r xy (Vy/Vx)	Ratio of Means
7		Ear Height	Thickness Lips	L		.04	.28	14
5		Face Breadth	Face Height	S		.25	.43	58
	4	Face Breadth	Face Height	S		.19	.60	31
10		Face Breadth	Face Height	L		.21	.27	78
6		Face Breadth	Min. Frontal Br.	L		.45	.61	74
4		Face Breadth	Min. Frontal Br.	S		.39	.45	87
	2	Face Breadth	Min. Frontal Br.	S		.35	.35	100
7		Face Breadth	Head Breadth	L		.53	.73	73
4		Face Breadth	Head Breadth	S		.56	.46	122
13		Head Breadth	Head Height	L		.27	.33	82
6		Head Breadth	Head Height	S		.28	.30	93
	7	Head Breadth	Head Height	S		.30	.33	91
6		Head Breadth	Min.Frontal Br.	S		.26	.40	65
	3	Head Breadth	Min.Frontal Br.	S		.25	.31	81
5		Head Height	Face Height	S		.14	.34	41
5		Head Length	Min.Frontal Br.	S		.22	.53	42
4		Head Length	Face Height	S		.16	.62	26
4		Head Length	Face Breadth	S		.28	.41	63
15		Head Length	Head Breadth	L		.34	.38	89
12		Head Length	Head Breadth	L	6-17	.22	.22	100
	12	Head Length	Head Breadth	L	6-17	.27	.28	96
32		Head Length	Head Breadth	L		.29	.33	88
	6	Head Length	Head Breadth	L			.31	
6		Head Length	Head Breadth	S		.10	.14	71
	6	Head Length	Head Breadth	S		.13	.16	81
14		Head Length	Head Height	L		.30	.40	75
	2	Head Length	Head Height	L				
6		Head Length	Head Height	S		.28	.36	78
	7	Head Length	Head Height	S		.30	.30	100
6		Horizontal Circum.	Head Length	L		.67	1.01	66
	1	Horizontal Circum.	Head Length	L				
7		Nose Breadth	Interpupillary Dist.	L		.50	.15	333
7		Nose Breadth	Thickness Lips	L		.14	.55	25
7		Nose Breadth	Ear Height	L		.24	.12	200

TABLE 51C

Body Dimensions. Means of Series

No. M	No. F	x	y	Material	Age	r xy (Vx/Vy)	r xy (Vy/Vx)	Ratio of Means
12		Head Length	Weight	L	6-17	.10	1.82	5
	12	Head Length	Weight	L	6-17	.10	1.72	6
12		Head Width	Weight	L	6-17	.08	1.39	6
	12	Head Width	Weight	L	6-17	.08	1.50	5
22		Humerus	Femur	S		.86	.83	104
6		Arm Length	Trunk Length	L		.35	.30	119
	1	Arm Length	Trunk Length	L		.36	.28	128
6		Arm Length	Leg Length	L		.70	.86	81
	1	Arm Length	Leg Length	L		.50	.67	75
8		Radius	Humerus	S		.94	.77	122
5		Shoulder Br.	Pelvic Breadth	L		.31	.47	66
6		Shoulder Br.	Pelvic Breadth (N.Y. Children)	L	3-8	.84	.52	162
	6	Shoulder Br.	Pelvic Breadth (N.Y. Children)	L	3-8	.60	.59	102
12		Sitting Ht.	Weight	L	6-17	.25	2.61	10
	12	Sitting Ht.	Weight	L	6-17	.22	2.22	10
12		Sitting Ht.	Head Length	L	6-17	.43	.23	187
	12	Sitting Ht.	Head Length	L	6-17	.45	.24	188
12		Sitting Ht.	Head Width	L	6-17	.35	.18	194
	12	Sitting Ht.	Head Width	L	6-17	.32	.16	200
9		Stature	Arm Length	L		.64	.91	70
	3	Stature	Arm Length	L		.48	.88	54
6		Stature	Arm Length (Radius)	L	3-8	.56	1.30	43
	6	Stature	Arm Length (Rad)	L	3-8	.49	1.42	34

TABLE 51C
(Cont.)
Body Dimensions. Means of Series.

No. M	No. F	x	y	Material	Age	r xy (Vx/Vy)	r xy (Vy/Vx)	Ratio of Means
16		Stature	Chest Circum.	L		.48	.66	73
6		Stature	Head Breadth	L		.22	.165	133
11		Stature	Head Height	L		.22	.26	85
12		Stature	Weight	L	6-17	.25	2.39	10
	12	Stature	Weight	L	6-17	.23	2.28	10
12		Stature	Sitting Height	L	6-17	.83	.84	99
	12	Stature	Sitting Height	L	6-17	.78	.79	99
12		Stature	Head Length	L	6-17	.48	.26	185
	12	Stature	Head Length	L	6-17	.45	.24	188
12		Stature	Head Width	L	6-17	.33	.18	183
	12	Stature	Head Width	L	6-17	.30	.15	200
18		Stature	Head Length	L	18-22 & Adults	.34	.26	131
4		Stature	Head Circum.	L	20-40	.34	.16	212
	4	Stature	Head Circum.	L	20-40	.30	.10	286
6		Stature	Leg Length*	L	3-8	.72	1.07	67
	6	Stature	Leg Length*	L	3-8	.61	.87	70
21		Stature	Leg Length	L	18-22	.63	1.22	52
5		Stature	Pelvic Breadth	L		.346	.79	44
6		Stature	Pelvic Breadth	L	3-8	.68	.77	88
	6	Stature	Pelvic Breadth	L	3-8	.49	.80	61
5		Stature	Shoulder Br.	L		.38	.57	67
6		Stature	Shoulder Br.	L	3-8	.65	1.14	57
	6	Stature	Shoulder Br.	L	3-8	.48	.78	62
5		Stature	Span	L		.62	1.01	61
	3	Stature	Span	L		.68	.93	73
10		Stature	Stem Length	L		.50	.79	63
6		Stature	Stem Length	L	3-8	.57	.64	89
	6	Stature	Stem Length	L	3-8	.63	.69	91
10		Stature	Stem Length	L	5-18	.79	.88	90
8		Tibia	Femur	S		1.05	.73	144
10		Tibia	Humerus	S		.90	.78	116
6		Tibia	Radius	S		.79	.80	99
5		Trunk Length	Pelvic Breadth	L		.276	.35	79
5		Trunk Length	Shoulder Breadth	L		.29	.25	118
5		Trunk Length	Leg Length	L		.18	.19	97

*Tibiale to Heel

TABLE 52A

Sex Difference in Lag in Adults and During Growth. Means of Series. Based on Preceding Tables ( ) Indicates Greater Acceleration. Ratio is Lag of x/Lag of y. Greater Lag Means Lower Relative Regression Coefficient.

Dimensions Paired x	y	Age	Amt of Greater Lag: Males x	Males y	Females x	Females y	Ratio M - F
Head Length	Head Breadth	Ad.				.02	
Head Length	Head Breadth	Ad.		.02			-10
Head Length	Head Breadth	6-17	.05	.06			04
Face Breadth	Face Height	Ad.		.17	.06		27
Face Breadth	Min. Frontal Breadth	Ad.			.04	.10	-13
Head Breadth	Head Height	Ad.	.02	.03			02
Head Breadth	Min. Frontal Breadth	Ad.			.01	.09	-16
Head Length	Head Height	Ad.	.02			.06	-22
Arm Length	Trunk Length	Ad.	.01			.02	-09
Arm Length	Leg Length	Ad.			.20	.19	06
Shoulder Br.	Pelvic Br.	3-8		.07	.24		60
Stature	Arm Length	Ad.			.16	.03	16
Stature	Arm Length	3-8			.07	(.12)	09
Stature	Weight	6-17		(.11)	.02		00
Stature	Sitting Ht.	6-17			.05	.05	00
Sitting Ht.	Weight	6-17		(.39)	.03		00
Stature	*Head Length*	*6-17*			.03	.02	-03
Stature	Head Width	6-17			.03	.03	-17
Sitting Ht.	Head Length	6-17	.02	.01			-01
Sitting Ht.	Head Width	6-17			.03	.02	-06
Head Length	Weight	6-17		(.10)			-01
Head Width	Weight	6-17				(.11)	01
Stature	Head Circum.	20-40			.04	.06	-74
Stature	Leg Length	3-8			.11	.20	-03
Stature	Pelvic Br.	3-8		.03		.19	27
Stature	Shoulder Br.	3-8			.17	.36	-05
Stature	Span	Ad.	.06			.08	-12
Stature	Stem Length	3-8	.06	.05			-02
Total		Ad.	.11	.22	.51	.65	-105
Total, Acceleration Omitted		3-8	.06	.15	.59	.75	86
Total, Acceleration Omitted		6-17	.07	.07	.19	.12	-23
Grand Total, Acceleration Omitted		All Ages	.24	.44	1.29	1.52	-42

TABLE 52B

Sex Differentials in Relative Regression Coefficients and in Their Ratios.
By Age, Worcester Males and Females ( ), Acceleration

x	y	Relative Regression Coefficients: r xy (Vx/Vy) M>F	r xy (Vx/Vy) M<F	r xy (Vx/Vy) M=F	r xy (Vy/Vx) M>F	r xy (Vy/Vx) M<F	r xy (Vy/Vx) M=F	Ratio M>F	Ratio M<F	Ratio M=F
(Stature)	Weight	6-7 9-10 13-15	8, 11, 16	12 17	6-7 11-12 14-16	8-10 13,17		6, 9-10 13-15 17	7-8 11-12 16	
Stature	Sitting Height	6-8 13-15 17	9-12 16		7, 9 11-12 16-17	8, 10 13-15	6	6, 8 10, 13-15	7, 9 11-12 16-17	
(Sitting Height)	Weight	6-7 9-11 13-15 17	8, 16	12	6-7 11-13 15-17	8-10 14		7, 9-10 14, 17	8, 11, 13, 16	6, 12, 15

SUMMARY OF LAGS

TABLE 52B
(Cont.)

Sex Differentials in Relative Regression Coefficients and in Their Ratios.
By Age, Worcester Males and Females ( ), Acceleration.

x	y	Relative Regression Coefficients								
		r xy(Vx/Vy)			r xy (Vy/Vx)			Ratio		
		M > F	M < F	M=F	M > F	M < F	M=F	M > F	M < F	M=F
Stature	Head Length	6 8-9 14-16	7 10-13 17		6-9 11-12 15-16	10 13-14 17		9 13-15	6-8 10-12 16-17	
Stature	Head Width	7-10 13 15-17	6 11-12 14		7-11 15-17	6 12 14	13	9 13-16	6-8 10-12 17	
Sitting Height	Head Length	6 8-9 14-15 17	7 10-13 16		6-8 15 17	10-14 16	9	9-10 13-17	6-8 11 12	
Sitting Height	Head Width	7-9 11 15 17	6 10 12-14 16		7-11 15 17	6 12-14 16		9 14-16	6-8 10-13 17	
(Head Length)	Weight	6 8 10-12 14-16	7 9 13 17		6 8 10-12 14-16	7 9 13 17		6 7 9-11 17	8 13 15-16	12 14
(Head width)	Weight	6 9-11 15	7-8 13-14 16	12 17	9 11 15-16	6-8 10 12-14 17		6-10 12 17	13-16	11
Head Length	Head Weight	7 12	8 10-11 13-17	6 9	7 12	9-11 13-17	6 8	9 11 14-16	8 10 12-13 17	6-7

TABLE 53A

Worcester, Massachusetts, School Children
Summary for All Ages (6-17)
(Boas & Wissler, 1904)

x	y	r xy	r xy (Vx/Vy)	r xy (Vy/Vx)	Ratio	Boys-Girls Relative Regression Coefficients
			BOYS			r xy (Vx/Vy)
Stature	Weight	.77	.25	2.39	10	.02
Stature	St. Ht.	.83	.83	.84	99	.04
St. Ht.	Weight	.74	.25	2.61	10	.03
Stature	Head L.	.35	.48	.26	185	.03
Stature	Head W.	.24	.33	.18	183	.03
St. Ht.	Head L.	.31	.43	.23	187	-.02
St. Ht.	Head W.	.29	.35	.18	194	.03
Head L.	Weight	.36	.10	1.82	5	-.00
Head W.	Weight	.32	.08	1.39	6	.00
Head L.	Head W.	.22	.22	.22	100	-.05
			GIRLS			(Vy/Vx)
Stature	Weight	.72	.23	2.28	10	.11
Stature	St. Ht.	.78	.78	.79	99	.05
Sitting Ht.	Weight	.70	.22	2.22	10	.39
Stature	Head L.	.32	.45	.24	188	.02
Stature	Head W.	.21	.30	.15	200	.03
St. Ht.	Head L.	.32	.45	.24	188	-.01
St. Ht.	Head W.	.22	.32	.16	200	.02
Head L.	Weight	.40	.10	1.72	6	.10
Head W.	Weight	.34	.08	1.50	5	-.11
Head L.	Head W.	.27	.27	.28	96	-.06

TABLE 53B

Influence on Lag of Holding Age Constant. Worcester Males (Boas & Wissler). Age in Month Constant for Each Year Interval. Correlations with Age by A. B. Mos. Vx/Vy, Relative Regression Coefficient, (i.e., Multiplied by r xy); (A). Age in Month Constant.

Age	6-6.11			7-7.11			8-8.11			9-9.11			Mean		
x - y	r xy	$\frac{V_x}{V_y}$	$\frac{V_y}{V_x}$	r xy	$\frac{V_x}{V_y}$	$\frac{V_y}{V_x}$	r xy	$\frac{V_x}{V_y}$	$\frac{V_y}{V_x}$	r xy	$\frac{V_x}{V_y}$	$\frac{V_y}{V_x}$	$\frac{V_x}{V_y}$	$\frac{V_y}{V_x}$	r
Stature-Weight	.86	.39	1.91	.78	.28	2.17	.69	.25	1.92	.72	.25	2.06	.29	2.02	.76
Stature-Weight (A)	.89	.40	1.98	.78	.28	2.17	.67	.24	1.86	.69	.24	1.97	.29	2.00	.76
r-r (A)	-.03	-.01	-.07	00	00	00	.02	.01	.06	.03	.01	.09	.002	.02	.01
Stat. St. Ht.	.78	.87	.70	.81	.79	.84	.83	.88	.78	.79	.77	.81	.83	.78	.80
Stat. St. Ht. (A)	.78	.87	.70	.80	.78	.82	.84	.88	.78	1.00	.98	1.02	.88	.83	.86
r-r (A)	00	00	00	.01	.01	.02	-.01	-.00	-.00	-.21	-.21	-.21	-.05	-.05	-.05
Sitting Ht.-Wt.	.77	.31	1.92	.79	.29	2.14	.52	.18	1.53	.70	.25	1.94	.26	1.88	.70
Sitting Ht.-Wt. (A)	.79	.32	1.98	.78	.29	2.11	.51	.17	1.50	.97	.35	2.69	.28	2.07	.76
r-r (A)	-.02	-.01	-.06	.01	.00	.03	.01	.01	.03	-.27	-.10	-.65	-.02	-.19	-.07
Stat.-Head L.	.30	.43	.21	.36	.43	.30	.44	.61	.32	.41	.51	.33	.50	.29	.38
Stat.-Head L. (A)	.30	.43	.21	.35	.42	.29	.42	.59	.30	.38	.47	.30	.48	.28	.36
r-r (A)	00	00	00	.01	.01	.01	.02	.02	.02	.03	.04	.03	.02	.02	.02
Stat.-Head Width	.20	.30	.13	.27	.35	.20	.19	.25	.15	.23	.30	.17	.30	.16	.22
Stat.-Head Width (A)	.20	.30	.13	.24	.31	.18	.19	.25	.15	.23	.30	.17	.29	.16	.22
r-r (A)	00	00	00	.03	.04	.02	00	00	00	00	00	00	.01	.01	.01
St. Ht.-Head L.	.34	.44	.27	.38	.46	.31	.45	.59	.34	.37	.47	.29	.49	.30	.38
St. Ht.-Head L. (A)	.34	.44	.27	.37	.44	.31	.46	.60	.35	.52	.65	.42	.53	.34	.42
r-r (A)	00	00	00	.01	.02	.00	-.01	-.01	-.01	-.15	-.18	-.13	-.04	-.04	-.04
St. Ht.-Head W.	.24	.32	.18	.29	.39	.21	.30	.37	.25	.29	.39	.22	.37	.22	.28
St. Ht.-Head W. (A)	.24	.32	.18	.24	.32	.18	.30	.37	.25	.30	.40	.22	.35	.21	.27
r-r (A)	.00	.00	.00	.05	.07	.03	.00	.00	.00	-.01	-.01	.00	.02	.01	.01
Head L.-Weight	.46	.14	1.48	.41	.12	1.37	.46	.12	1.77	.39	.11	1.39	.12	1.60	.43
Head L.-Weight (A)	.41	.13	1.32	.41	.12	1.37	.43	.11	1.65	.48	.13	1.71	.12	1.61	.43
r-r (A)	.05	.01	.16	.00	.00	.00	.03	.01	.12	-.09	-.02	-.32	.0	-.01	.00
Head Width-Wt.	.40	.12	1.33	.20	.05	.74	.25	.07	.89	.40	.11	1.48	.09	1.11	.31
Head Width-Wt. (A)	.36	.11	1.20	.16	.04	.59	.26	.07	.93	.41	.11	1.52	.08	1.06	.30
r-r (A)	.04	.01	.13	.04	.01	.15	-.01	.00	-.04	-.01	.00	-.04	.01	.05	.01
Head Lg.-Head W.	.30	.31	.29	.18	.20	.16	.14	.13	.15	.29	.31	.27	.24	.22	.23
Head Lg.-Head W. (A)	.25	.26	.24	.15	.16	.14	.16	.15	.17	.29	.31	.27	.22	.20	.21
r-r (A)	.05	.05	.05	.03	.04	.02	-.02	-.02	-.02	.00	.00	.00	.02	.02	.02

LAGS IN LOWER ANIMALS

TABLE 54

Lag in Eupagurus Prideauxi
(Schuster, *Biometrika*, 2:195, 210)

x_1 Measurement No. 1 $l_1, \frac{x_3}{x_1}$ x_2 Right Chela Length $l_2, \frac{x_3}{x_2}$

x_3 Carapace Length $l, \frac{x_2-x_1}{x_2}$

	Male		Female	
	Deep Sea	Shallow	Deep Sea	Shallow
N	483	550	470	554
$r\ x_1x_3$	.95	.93	.85	.84
$r\ x_1l_1$	-.85	-.81	-.49	-.47
$r\ x_2x_3$	.94	.95	.86	.88
$r\ x_2l_2$	-.78	-.77	-.45	-.38
$r\ x_3l_3$	-.52	-.44	"Insensible"	"Insensible"

TABLE 55

Paramecium (Pearl, *Biometrika*, 5:61, 64, 225-240, 1906-07)

x, Length of Body
y, Breadth of Body $l, \frac{y}{x}$

Series	Group	No.	r xy	r xy(Vx/Vy)	r xy(Vy/Vx)	r xl	r yl
A	Non-conjugants	210	.59	.44	.79	-.18	.37
	Conjugants	210	.28	.20	.39	-.41	.49
E	Non-conjugants	132	.68	.63	.73	-.33	.39
AA	Conjugants A	200	.40	.25	.65		
	Conjugants B	200	.37	.21	.65		
D	Conjugants	202				-.60	.61
	Non-conjugants	202				-.27	.39
A	Unfavorable Conditions	207	.68	.68	.68	-.45	.41
B	Favorable Conditions	175	.62	.68	.56	-.39	.43

TABLE 56

Young Trout, at Intervals of Four Weeks of Age

$l, \frac{y}{x}$

x	y	Stage I		Stage III		Stage V		Stage I		Stage III		Stage V	
		r xy	r xl	r xy	r xl	r xy	r xl	r xy $\frac{Vx}{Vy}$	r xy $\frac{Vy}{Vx}$	r xy $\frac{Vx}{Vy}$	r xy $\frac{Vy}{Vx}$	r xy $\frac{Vx}{Vy}$	r xy $\frac{Vy}{Vx}$
Total Length	Breadth Caudal Fin	.89	.69	.74	.51	.73	.38	.40	1.98	.24	2.24	.32	1.64
Total Length	Breadth of Body	--	--	.790	.326	.87	.15	--	--	.46	1.36	.69	1.10
Total Length	Length Ant. Dorsal Fin	.76	.260	.493	.192	.60	-.58	.45	1.29	.16	1.53	.72	.50
Total Length	Length Ventral Fin	.84	.61	.584	.369	.61	.03	.34	2.05	.15	2.23	.32	1.17
Total Length	Length Post. Dorsal Fin	.45	.08	.452	.119	.52	.08	.21	1.76	.15	1.32	.24	1.13
Total Length	Length of Head	.94	.65	.729	-.071	.95	-.53	.63	1.40	.57	.94	1.02	.71
Length of Head	Diameter of Eye	.77	-.47	.646	-.564	.65	-.63	.26	.70	.78	.54	.84	.50
Length Anterior	Posterior Dorsal Fin	.43	-.31	.441	-.574	.39	-.00	.12	.60	.48	.40	.15	1.00
Length Ventral	Posterior Dorsal Fin	.52	-.53	.646	-.659	.58	-.34	.28	.52	.84	.50	.50	.65
Position of Pectoral	Pelvic Fin	.87	-.90	.691	-.629	.82	-.28	.87	.46	.90	.53	.81	.83

TABLE 57

Brittle Star (Ophiocoma Nigra)
(*Biometrika*, 2:370, 1902-03)

N, 1000

r Arm Length (x) - Disc Br. (y)	r x $\frac{y}{x}$	r xy(Vx/Vy)	r xy(Vy/Vx)
.93	-.31	.98	.89

TABLE 58

Fiddler Crab (Duncker, *Biometrika*, 2)

Ch, Meropoditenlänge des Scherenpaares
G, Meropoditenlänge des Gangbeinpaares
C, Carpopoditenlänge des Scherenpaares
P, Propoditenlänge des Scherenpaares
N, About 400
s, Left Side
d, Right Side

	x	y	r xy	r xl	r xy(Vx/Vy)	r xy(Vy/Vx)
Righthanded	Gs	Chs	.80	-.24	.76	.94
		Chd	.93	-.24	.80	.95
	Gd	Chs	.90	-.31	.79	.80
		Chd	.94	-.30	.85	.94
	Ps	Cs	.62	-.41	.60	.64
		Cd	.56	-.43	.54	.59
	Pd	Cs	.60	-.43	.59	.61
		Cd	.84	-.24	.91	.96
Lefthanded	Gs	Chs	.95	-.30	.86	.84
		Chd	.80	-.34	.91	.79
	Gd	Chs	.93	-.24	.81	.86
		Chd	.90	-.28	.78	.92
	Ps	Cs	.54	-.28	.84	.94
		Cd	.64	-.32	.57	.71
	Pd	Cs	.62	-.49	.66	.58
		Cd	.65	-.38	.62	.68

TABLE 59

Skull and Bones of the Nebraska Muskrat
125 Individuals
(Latimer & Riley, J. of Morph., 55:205,208, 1934)

$l, \frac{y}{x}$

	r xy	r xl	r xy(Vx/Vy)	r xy(Vy/Vx)
x, Skull Length y, Dimension				
Basilar	.95	.15	.86	1.06
Nasals	.81	.26	.52	1.27
Palatine Slits	.49	.11	.19	1.29

TABLE 59
(Cont..)

Skull and Bones of the Nebraska Muskrat
125 Individuals

	r xy	r xl	r xy(Vx/Vy)	r xy(Vy/Vx)
x, Skull Length y, Dimension				
Postpalatal	.79	.06	.59	1.05
Fronto-occipital	.72	-.34	.70	.74
Maxillary Teeth	.64	-.37	.60	.68
Diastema	.84	.28	.58	1.22
Mandible	.86	-.19	.53	.90
Breadth	.47	-.73	.66	.34
Bizygomatic	.76	-.07	.61	.95
Interorbital	.53	-.13	.74	.63
Biparietal	-.29	-.67	.14	.29
Humerus	.82	.10	.61	1.08
Radius	.80	.10	.59	1.08
Ulna	.74	-.19	.64	.85
Femur	.82	.20	.58	1.16
Tibia	.82	.08	.63	1.06
x, Biparietal Diameter y, Dimension				
Head Breadth	.14	-.89	.28	.07
Interorbital	.08	-.64	.07	.01
Palatine Slits	.005	-.49	.003	.001
Maxillary Teeth	-.18	-.84	-.23	-.13
x, Skull Weight y, Wts. of other Parts of Body				
Mandible	.93	-.74	1.24	.70
Humerus	.82	-.01	.68	.99
Radius & Ulna	.78	-.005	.62	.99
Femur	.84	-.01	.69	1.01
Tibia	.87	-.02	.77	.99

TABLE 60

12 Turkey Hens

(Latimer, *Anat. Rec.*, 34:17-23, 1926; 35:366-375, 1927)

x, Length of Body
y, Length of $l, \frac{y}{x}$

Humerus	.77	-.77	1.16	.51
Radius	.65	-.88	1.36	.31
Ulna	.76	-.87	1.44	.40
Femur	.66	-.78	1.32	.33
Tibia	.83	-.77	1.24	.55
Tarsometatarsus	.39	-.95	1.42	.56
Wing	.62	-.72	.87	.44
Head(width)	.27	-.94	.76	.95
Leg	.91	-.87	1.46	.57

TABLE 61

LAGS IN LOWER ANIMALS

Correlation and Lags of Body Weight (x) with Weights of
Various Organs and Parts of the Body (y) in 12 Turkey Hens.

l is y/x

(Latimer, Anatomical Record, 34:17-23, 1926; 35:366-375, 1927.)

Weight (y) of:	r xy	r xl	r xy (Vx/Vy)	r xy (Vx/Vy)
Eyeballs	.87	-.75	1.22	.62
Heart	.85	-.24	.83	.87
Integument	.85	.22	.62	1.16
Musculature	.83	-.14	.76	.91
Empty Digestive Tract	.81	-.73	1.13	.58
Ligamentous Skeleton	.80	-.70	1.12	.57
Kidneys	.79	.24	.51	1.23
Liver	.75	.45	.31	1.79
Spinal Cord	.73	-.87	1.46	.36
Head	.71	-.90	1.56	.52
Suprarenals	.69	.27	.34	1.41
Brain	.61	-.97	2.20	1.69
Spleen	.48	.26	.12	.20
Oviduct	.43	.32	.06	3.31
Ovary	.40	.30	.04	3.64
Pancreas	.25	-.33	.15	.42
Lungs & Trachea	.20	-.22	.08	.48
Hypophysis	-.07	-.56	-.04	-.11
Feathers	-.21	-.82	-.25	-.18
Thyroid	-.56	-.75	-.21	-1.47
Thymus	-.60	-.69	-.10	-3.75

TABLE 62

Weights of Organs of 119 Male Turtles, and 29 Male and Female Frogs

(Latimer, Anatomical Record, 19:347-360, 1920)

l, Y/X		Male Turtles				Male & Female Frogs			
x	y	r xy	r xl	r xy(Vx/Vy)	r xy(Vy/Vx)	r xy	r xl	r xy(Vx/Vy)	r xy(Vy/Vx)
Body Weight	Digestive Tract	.79	-.02	.64	.98	.37	.54	.47	1.60
Body Weight	Liver	.63	.12	.34	1.17	.84	.50	.45	1.57
Body Weight	Kidneys	.61	-.03	.39	.96	.86	.26	.63	1.18
Body Weight	Heart	.54	-.45	.52	.55	.66	.62	.41	1.07
Body Weight	Spleen	.43	.17	.12	1.55	-.06	-.35	-.02	-.20
Body Weight	Pancreas	.39	-.03	.16	.94	.91	.67	.48	1.71
Body Weight	Lungs	.16	-.23	.06	.40	.73	.17	.45	1.19
Body Weight	Testes	.09	-.22	.03	.29	--	--	--	--
Liver	Spleen	.73	.30	.38	1.42	.00	-.50	--	--
Kidneys	Liver	.65	-.26	.55	.76	.65	-.11	.48	.88
Liver	Pancreas	.63	-.18	.48	.82	.66	-.40	.65	.67
Digestive Tract	Kidneys	.62	-.21	.49	.79	.88	-.70	1.18	.65
Digestive Tract	Liver	.36	-.32	.24	.54	.72	-.36	.72	.73
Digestive Tract	Spleen	.25	-.09	.09	.74	.86	.48	.50	1.48
Kidneys	Lungs	.23	-.37	.14	.37	-.02	-.66	-.52	-.03
Heart	Digestive Tract	.25	-.52	.21	.30	.53	-.38	.46	.61
Heart	Lungs	.14	-.26	.06	.35	.40	-.55	.39	.40
Pancreas	Spleen	.45	-.24	.30	.68	-.11	-.58	-.06	-.18

SUMMARY ANALYSIS OF LAGS

A summary of lags of various compared dimensions, in which values for males are given for 4 or more series, is presented in the accompanying tables. The following observations are based on that summary, and on preceding tables.

HEAD AND SKULL

Face breadth does not show the usual lags when correlated with index $\frac{\text{Head width}}{\text{Face breadth}}$ for means of racially homogeneous groups, but is positively correlated with the index (Peruvians; Eskimo). Face breadth is positively correlated with $\frac{\text{Nasal breadth}}{\text{Face breadth}}$ in 7 series, negatively correlated in 7 series. There is negative correlation in the two large Egyptian series.

There is marked lag in face height-face breadth, both intergroup and intragroup, *the lag in every instance being greater in face breadth. In the living,* face breadth lags more on minimum frontal diameter than conversely; in skulls, however, in 3 of 6 series minimum frontal diameter shows the greater lag. Similarly, in the living, face breadth lags on head breadth more than conversely in 6 of 7 series; whereas in skulls the reverse applies to 5 of 6 series. In three series of means of homogeneous groups (1 Peruvian, 2 Eskimo series) *there is positive correlation of face breadth with head breadth/face breadth,* thus indicating less lag of head breadth than of face breadth. Face breadth lags less on head height and head length than conversely, except in Egyptian males and in a series of ethnic groups of both sexes combined.

Face height shows less lag on head height, head length, and head breadth than conversely, including ethnic group means.

Minimum frontal breadth lags less on head height and head length than conversely, except for ethnic group means.

Face height-nose height show almost equivalent mutual lags.

Basion-alveon diameter lags much more on face height than conversely.

In the living head breadth lags more on head height than conversely in all European series, and less than head height in all Negro and Negro hybrid series. In skulls, European and Egyptian series, the relationship found in European living is reversed.

In the large number of living groups for which head length and breadth are given, lag of breadth on length is less than lag of length on breadth, except in 3 groups of Orensteen's series of living Egyptians in which there is no differential in lag of breadth-length. A given percentage change in breadth, therefore, influences cranial index more than does an equivalent percentage change in length. In the series of ancient Egyptian skulls (Pearson and Davin), Tenerife (Hooton) and Macdonell's series of 3000 living English males lag of length on breadth is greater than the converse. This differential in skull and head lags in adults seems, therefore, to be well established for large series. The mean positive correlation of head breadth with cephalic index is higher than the mean negative correlation of head length with cephalic index. This differential in coefficient of correlation of respective dimension with index corresponds with the differential in lag. In only 4 of the 44 series analysed does head breadth show greater lag than head length. Two of these 4 series contain each 25 observations or less; the others are means of ethnic groups.

In most series of skulls head breadth lags more on minimum frontal diameter than conversely; but the opposite applies to Merovingian males and ethnic group means. Head breadth lags much less on head circumference than conversely; head length, however, shows less lag on head circumference; indeed often shows acceleration. Transverse and sagittal arcs lag less on horizontal circumference than horizontal circumference on either of them. Otherwise, with the exception of skull length, sagittal arc lags more against each of 9 dimensions than any of these on sagittal arc. In the living, head height lags less on head length than conversely in all European series; the reverse is the case in 4 of 6 Negro and Negro hybrid series. In skulls, including means of ethnic groups, height has the lesser lag, with the exception of a small Andamanese series and three Pecos Indian series.

Nasal breadth lags less on nasal height than conversely, except in Pecos males, in skulls; in the living, Negro and Negro hybrids, nasal breadth shows less lag than inter-pupillary distance or ear height; but greater lag than thickness of lips, except in 1 series.

Ear height and thickness of lip show no consistent type of differential in lag, the ratio ranging from 12 to 200. The lags, which are very great for ear height, range from -.05 to .18; whereas they range from -.40 to 1.00 in thickness of lips.

Orbital breadth lags more on orbital height than conversely. In the Egyptian series palate breadth lags less on palate length than the converse; the reverse applies to Pecos Indians.

BODY DIMENSIONS

Tibia is slightly accelerated on femur, the latter consistently lagging on tibia (.86-.00); and lags less upon humerus than humerus upon tibia. There is approximately the same amount of lag of tibia on radius as of radius on tibia. Humerus lags less on radius than conversely; but more on femur than conversely, though the reverse occurs in several series. Forearm length lags more on foot length and finger length than conversely; and foot length lags more on finger length than conversely. Dimension of bones of the finger, and total finger length show several differentials in lags, for details of which the table should be consulted. Length of right second digit lags on lengths of 3rd, 4th, and 5th, whereas each of these is accelerated upon right second finger length. Right 3 is accelerated upon right 4 and 5, and right 4 upon right 5.

Weights in the bones of the hand show some differentials in lag. Lesser multangular and pisiform show less lag than any of the compared bones against these. Fifth distal phalanx lags considerably against each other distal phalanx, the latter showing considerable acceleration on fifth distal.

Head circumference lags more on head height, stem length, arm length, and leg length, than any of these on head circumference, the ratios ranging from 30 to 40. Arm length lags on leg length more than leg length on arm length, ratios ranging, in large series, from 75 to 05. Arm length lags less on trunk length than conversely, ratios ranging from 110 to 134. Leg length lags less on trunk length than the converse, although there is little difference, the ratios ranging from 88 to 102. The lags in trunk length--leg length are approximately double those in arm length--trunk length and four times those in arm length-leg length (all large series). Pelvic breadth lags less on shoulder breadth and trunk length than conversely, the ratios ranging from 62 to 71 for shoulder breadth, and from 76 to 93 for pelvic breadth. Lag of shoulder breadth on pelvic breadth is very nearly the same as lag of arm length on trunk length. Pelvic breadth lags more on trunk length than on shoulder breadth. Shoulder breadth lags more on trunk length than conversely (ratios 106-123).

Arm length lags on stature less than stature on arm length; in fact, the series show no lag in arm length, and 1 series shows a slight acceleration of arm length. Ratios range from 54 to 99.

Coefficients of correlation of stature with arm length/stature range from

-.25 to .21; and of stature with leg length/stature from -.25 to .29.

When the index is $\frac{\text{dimension}}{\text{stature}}$, stature is positively correlated with index in the case of femur, femur *plus* tibia, foot length, hand length, tibia length. It is negatively correlated with index in the case of forearm length, foot breadth, head length, head module, shoulder breadth, span, sitting height. Stature lags on leg length, and lags on forearm length more than forearm length lags on stature. Stature shows the greater lag when paired with arm length, chest circumference, finger length, foot length, cranial capacity (means of groups), leg length, pelvic breadth, shoulder breadth, sitting height, stem length, span; stature shows the lesser lag when paired with head breadth (including means of ethnic groups), excepting in Pure Sioux, head length, face breadth, face length, (means of Russian groups, MF), head circumference; there is no consistent differential relative lag for stature-head. height.

Bardeen finds that in adults relative sitting height varies inversely as the cube root of stature. That is, $\frac{100(\text{S.H.}^{1/3})}{\text{Stature}} = k$ (a constant). The constant has differential group values. He uses means of stature and sitting height for the entire group in deriving his constant. "This constant, determined for a given race, sex, and age period makes a convenient index of relative sitting height." (*Am. J. Phys. Anthropol.*, 6:355, 1923).

SEX DIFFERENCES IN LAG

In the Egyptian series of Pearson and Davin (*Biometrika* 16, 1924) there appear to be few significant sex differences in values of r xi, with the exception of transverse arc-zygomatic breadth, which shows less lag in females than in males. Males have a lower value of coefficient than females in 36 of 71 instances. The greatest sex difference in r xi is .272. In only four other instances is the sex difference as great as .1. Mean excess of males over females in 71 correlations is .004(r xi).

There are significant sex differences in some ratios of lag in this series. Thus dimensions have a higher ratio of lag on maximum length of skull in males than in females in all 9 instances, with the greatest difference in ratio of lag of bizygomatic breadth-skull length. In dimensions paired with skull breadth the ratio is lower in males in 6 pairs, higher in 1, and the same as in females in 1, the greatest differential being with basio-bregmatic height and auricular height. Ratio of dimensions with bizygomatic breadth is lower in males in all instances, the greatest differential being with basio-bregmatic height and auricular height. Dimensions paired with horizontal circumference have higher ratio in males in 4 pairs, lower in 1. Other dimensions show higher ratios of lag against sagittal arc in males than in females in 9 of 10 instances. Relative regression coefficients, therefore, reveal certain sex differentials in lag which are not disclosed by the correlation of dimension with index (r xi). Inspection shows that there is no consistent relation between relative amount of lag and ratio for the sexes in a given pair of dimensions. That is, the sex having the higher ratio may or may not have the greater amount of lag. Mean excess of male ratio of lags over female in 71 paired dimensions is 2.32. In 71 comparisons males have a mean lag of x dimensions of .317, and of y dimensions of .434. The corresponding values for females are .299 and .423. Thus females show slightly greater mean lag than males in this series. Though the differences are small, the numbers in each series are large (700 M, 400 F) and the mean difference is probably statistically significant. (Mean coefficient of correlation of dimensions (r xy) is slightly higher in males than in females in this series).

Table 52A, giving means of series, indicates that in adults females more frequently than males show the greater lag (lower coefficient of relative regression). The total greater lag, for paired dimensions listed in this table, are almost five times as great in females for x lags, and nearly three times as great for y lags. For the age group 3-8 the greater x lags in females total almost ten times the value of greater x lags in males, the y lag excess in females is five times the y lag excess in males. For the age group 6-17 the respective values in females are approximately three times and two times the value in males. It seems clear, therefore, that when total analyses are considered, females show greater lag than males, both during growth, at year intervals, and as adults.

The total ratio of lags is less in males than in females, for ages 6-17 and for adults, but is greater for age 3-8, the grand total showing lower ratio in males. The sex difference in ratio differs greatly from one pair of dimensions to another. During growth (6-17) it is very small or nonexistent when weight or sitting height is one of the paired dimensions.

Among adults males show greater lag than females in face height on face breadth, and pelvic breadth on shoulder breadth.

Females show much greater lag in arm length on leg length and leg length on arm length than do males, and considerably greater lags (.09 and .10) of minimum frontal breadth on head breadth and on face breadth. Stature lags on arm length much more than in males (.16) and arm length on stature slightly more (.03). Stature-head circumference likewise show greater lag in females, as does span on stature. Stature, however, lags on span more in males than in females. Head height lags on head length more in females (.06) than in males. The greatest sex differential in ratio of lags is for stature-head circumference (-74), face breadth-minimum frontal breadth (27) and head length-head height (-22).

During growth (3-17) females generally show the greater lag in each dimension when stature is one of the paired dimensions, but in females 3-8 arm length is more accelerated on stature than in males.

For total age range 6-17 boys show less lag than girls in each pair of variables except sitting height-head length and head length-head width. Lag in girls is less in each of these latter two pairs of variables. The greatest sex differential is in lag of sitting height on weight, which is less in boys than in girls. Where acceleration occurs it is greater in boys than in girls, with the exception of acceleration of weight on head width, which is greater in girls than in boys.

DIFFERENTIAL LAGS IN DIMENSIONS AT AGE LEVELS DURING GROWTH

Inasmuch as proportions of body and head change during growth one would expect the phenomenon of lag to show differential values at various ages. Thus if cephalic index decreases during growth one would expect for a given age period during growth, such as 6 years of age, a greater lag in head breadth on length than of length on breadth. Since most series give age to nearest year, and the age of individuals grouped at a given year level has a range of 12 months these individuals are not of uniform age. Hence the so-called age level is really a grouping of individuals of specified limited age range. This qualification applies to all of the above series except the California children, all of whom were measured at the same postnatal age.

The following is an analysis of trends during growth. In Wallis' series, age 3-8 by year intervals, shoulder breadth of males lags on pelvis breadth less than the converse, except at age 3; in females, there is no consistent difference. Stature lags on other dimensions with which it is compared--shoulder breadth, pelvis breadth, trunk length, leg length, radius length--more than any of these on stature. In the London School boys, age 5-13, stature is accelerated on stem length, stem length and chest girth lag on stature. In Westminister boys, age 12-18, stature lags on stem length and chest girth. Stem length lags on chest girth more than chest girth on stem length. In Manchester boys, age 11-18, by year intervals, stature lags more on stem length for ages 11-14, and less for ages 15-18, than stem length on stature. Thus, as indicated by Wallis' series, both age level and sex affect differential in these two dimensions at certain age ranges.

In the Worcester series, age 6-17 by year intervals, male stature lags less on sitting height than the converse for ages 6, 8, 10, 13-14, sitting height showing less lag on stature than the converse for ages 7, 9, 11, 15-17. Stature lags less on head length and head breadth in each age group than the converse. In females stature lags less on sitting height than the converse for ages 6-12, 16, and more for ages 13-15, 17. In females as in males, stature lags less on head length and head breadth than either of these on stature. This is consonant with the trend during growth, when stature increases relatively faster than head length or head breadth. In males head length-head breadth shows less lag of head length for ages 6-7, 9, 13-16, and less lag of head breadth for ages 8, 10-12, 17. In females head length shows less lag on head breadth for ages 6-10, 13, and head breadth less lag on head length for ages 11-12, 14-16, the values being the same at age 17. For the total series, 6-17, lag of head length on head breadth is the same as lag of head breadth on head length for boys, and differs by only .01 in girls. For the total Worcester series stature lags more on sitting height than sitting height on stature, but less on head length and head breadth than either of these on stature. Sitting height, likewise, shows less lag on these head dimensions than either of them on sitting height.

In Oxford Undergraduates, age 18-22, by year intervals, stature lags on leg length, and thigh length, each of which is accelerated on stature. Stature lags less on head length and head breadth than either of these on stature, the only exception being equal lags of stature-head breadth at age 18. These differentials repeat those of the above series of younger age groups.

To test further the effect on lag of holding age constant we partialled out age in months in Worcester males for the respective year intervals 6-9 years of age, in which age is given to nearest month. The effect on lag is indicated by the coefficient of partial correlation. In this series, holding age constant by month rather than by year has little influence on lag. About the only exceptions are stature-sitting height, sitting height-weight, and sitting height-head length, and these only in the 9 year old group. In only one age group is there a change in lag of stature-head width when age in month rather than in year is held constant. In three age groups there is slightly increased lag in stature-head length when age in month is held constant. Lag in head length-head width increases at ages 6 and 7, decreases at age 8, and is the same as for zero order of correlation at age 9. The result of holding age in month constant within a year range during these years of growth appears, therefore, to vary with dimensions and also with age level, but in the main the lag remains the same.

Inasmuch as holding age in months constant, within year intervals, has very little influence on coefficient of correlation, there is little influence on respective lags of dimension; for ratio of coefficients of variation (Vx/Vy) remains the same.

Mean lag of these four age groups is decreased by partial correlation (age in month constant) for stature-sitting height, sitting height-weight, sitting height-head length. It is increased for stature-head length, sitting height-head width, head length-head width. Partial correlation gives greater acceleration of weight on sitting height, and less acceleration of weight on head width.

The only comparison which can be made with California children is for length-stem length (California children) and stature-sitting height (Worcester males). In the former the lag of stem length on body length is .87; in Worcester males, age in mean month constant, it is .83; in the former the lag of body length on stem length is .78; in Worcester children lag of stature on sitting height is .80. It is not clear, therefore, that there are differentials in lags of these dimensions at these respective age periods, when age in month is held constant.

A comparison of lags during growth, at year intervals for mean age, with lags during adulthood shows the following: During growth head length lags less on head breadth than conversely for ages 6, 7, 9, 13 in males, and 6-10, 13 in females; the converse holds for ages, 8, 10-12, 17 in males, and 11, 12, 14-16 in females. In all large adult series head length lags more on head breadth than conversely.

Chest circumference - pelvic breadth show greater lags in U.S. soldiers than in California children up to 3 years of age (by 3 months intervals), but the ratio of soldiers is similar to that of children up to 12 months of age. The ratio then rises, from 47 to 73, to age 36 months. Lag in these children decreases in chest circumference from 1 month to 36 months and increases in pelvic diameter.

California children (1 month to 36 months) show less lag of pelvic breadth on shoulder breadth than conversely, the ratio ranging from 34 to 78. In New York children the ratio ranges from 90 to 208 in males, and from 76 to 123 in females, for 3-8 years of age, but with greater mean lag in pelvic breadth. In the Swedish series of males 21 years of age the ratio ranges from 64 to 71, pelvic breadth showing uniformly less lag than shoulder breadth. In New York children lag in pelvic breadth decreases with age, but females show no certain trend. California children likewise show no certain trend. In the last mentioned the greater lag of trunk length on pelvic breadth than conversely is duplicated in Swedish adults, but there are marked differences between the two series. In California children the ratio ranges from 22 to 63; in Swedish male adults, it ranges from 74 to 83. Moreover, the lag in pelvic breadth in Swedish adults is about 3 times that of the California children, from .33 to .36 as compared with .73 to 1.23 (acceleration) in the children. Mean lag in trunk length in Swedish adults is, conversely, greater than in the children: .26-.29 as compared with .19-.48 in the latter. Except for the 36 month group the ratios of lags in trunk length-shoulder breadth are below 100 (44-90), whereas in Swedish male adults, the ratios range from 106 to 123. In the adults the lag in shoulder breadth is about twice as great as in the children, and the lag in trunk length is more marked in the adults (.24-.31 as compared with .83-.59). New York children (2-8) show acceleration of arm length on stature for both sexes (.89-1.43 for males; .99-1.09 for females) and a lag of .51-.61 and .36-.60 of stature on arm length. In 1 series (Egyptians, males) adults show acceleration of arm length on stature, and in other series show little lag of arm length on stature (.84-1.03). In adult series stature lags on arm length .49-.71. The ratio of lags is, however, higher in adults than in New York children, 54-87, as compared with 36-69 in male children aged 2-8, and 24-54 for female children of this age range.

Chest circumference lags on stature less than conversely at each age interval and among adults. When, however, the age group 5-13, males, is considered as a unit, stature accelerates on chest circumference. For 11-18, and 12-18 years chest circumference is slightly accelerated on stature when these respective groups are treated as a series.

Head breadth lags more on stature than conversely at each age level, 6-17. The highest ratios in males occur at ages 13, 14, and 15, and in females at ages 7 and 11. In males the lowest ratio occurs at age 17 (100) and in females at age 15 (125).

In adults the ratios range from 99 to 173, as compared with 100 to 300 in males and 125 to 200 in females for age periods 6-17 years. Oxford undergraduates, 18-22 years of age, show ratios, by year level, of 100 to 162. Thus the differential which characterizes growth is continued to age 22. Means of 83 ethnic groups show greater lag in head breadth than in stature, and greater lags in each than are found in other series.

In males, lags in head height-stature by year intervals 18-22 conform with lags in adults, except that lag of head height on stature is less for year intervals 18-22 than for adults.

The ratios of lags are comparable for age levels 18-22 and for adults: 72-125 for adults, 58-106 for age levels 18-22, a lower average in the latter group. Fifty-three ethnic group means show a ratio of 167, which is higher than that of any other series analyzed. Here the intergroup differential is more emphatic than the intragroup differential in lag.

At age levels 6-22 head length lags more on stature than conversely. The same differential is found in every series of adults, but the ratio is lower in adults than during growth, and decreases from 6 years to 16 years. Thus in males the ratio ranges from 205 at 6 years of age to 138 at 16 and 111 at 17, in Worcester children; and in females from 254 to 121 at 17. In Oxford undergraduates it ranges from 110 at 18 to 139 at 22, being 138 among Cambridge total undergraduates. The range for other series of adults is 113-179. A series of 83 ethnic group means gives a ratio of 186.

Leg length lags less on stature than the converse at each age level, 3-8, 18-22, and for adults. In fact, in males leg length is accelerated on stature at ages 4-6, 8, and 18-22, the maximum acceleration appearing at age 18. In females age 3-8, acceleration of leg length appears only at age 4. With the exception of this age group females show, for ages 3-8, greater lag of leg length on stature at each year level. (The numbers, however, are small--11-26). From 18-22 upper leg length shows comparable acceleration on stature (1.32-1.65) at each respective age level; this is a higher acceleration than that of leg length, or of lower leg length.

With two exceptions, both males and females show less lag of pelvic breadth on stature than conversely, for ages 3-8 (numbers 14-24). Adults show the same type of differential, but a more emphatic one. Thus in male adults the ratio ranges from 42 to 48, and in male children 3-8 it is 69-126. In males plus females age 3 months to 36 months the ratio is 22-61, that is, closer to the ratio of adults. At most of the age levels 3 months to 36 months there is acceleration of pelvic breadth on stature and much more lag of stature on pelvic breadth than during the period 3-8 years.

From 3 months to 36 months shoulder breadth lags less on stature than conversely, except at 36 months, the ratios ranging from 39 to 117. At age 3-8 years the same is true, except at age 3 in males.

Adult males show the same type of differentials; ratios range from 65 to 69 in Swedes at age 21, and 44 to 66 in Sioux.

In California children stature-stem length have equivalent lags at 3 months and 18 months. At all other age intervals in this group stature has the greater lag. Among New York children males show greater lag of stature at ages 3-5 and 7, and lesser lag of stature at ages 6 and 8. Females of this series show greater lags of stature at ages 4, 6-8, and smaller lags at 3 and 5. Worcester children likewise show reversals of ratio of lag at different age levels. Thus in males stature has less lag at ages 6, 8, 10, 13, 14, and greater lag at 7, 9, 11, 12, 15-17; in females there is greater lag of stature at ages 6, 13-15, 17, and less lag at ages 7-12, 16. For the total group (not by year levels) of London boys 5-13, the ratio is 53, and stem length is considerably accelerated upon stature. For the Westminster boys age 12-18, as a group (not by year intervals), stem length is slightly accelerated upon stature, and the ratio is 80. In the large series of U. S. soldiers the ratio is 100; all other adult groups yield ratios considerably below 100, from 43 (in females) to 81 in males. In Swedish males, 21 years of age the total is 56 (64-61). Holding age constant appears to have considerable influence on the ratio of these lags during adulthood as well as during growth. The same observation applies to many other paired lags.

LAG IN LOWER ANIMALS

Inasmuch as lag is a characteristic of man, it seems likely that it may characterize other animals also. We have sampled some of the available data with the following results: In 500 individuals of species Arcella vulgaris, a shelled rhizopod, correlation of total (outer) diameter of the shell (Y) with (inner) diameter of the mouth opening (X) is .836. The r of $Y - \frac{Y}{X}$ is .71, of $Y - \frac{X}{Y}$ is -.62. (Pearl and Dunbar, Biometrika, 2:327, 330, 1902-1903). Schuster gives measurements of dimensions of about 2,000 individuals of species Eupagurus prideauxi, divided into the two groups of deep water forms and shallow water forms. He measures the two dimensions, (1) from upper articulation of propodite with carpopodite of right chela to upper and outer articulation of propodite with dactylopodite, known as Measurement No. 1; and (2) length of right chela measured from its lower articulation with the carpopodite to furtherest point of the fixed blade of scissors. He believes his measurements accurate to 0.1 mm. From these two measurements he constructs the chela index, which is $\frac{\text{Measurement No. 1 - Measurement No. 2}}{\text{Measurement No. 2}}$. He also takes length of carapace along median line. Regression coefficient of this index on carapace length is -.27 and -.24, respectively; of carapace length on index, -.90 and -.81, respectively.

Lag is marked except in the female in one correlation. There is a distinct sex difference, though not always in the same direction, in the respective lags. In this series, higher positive correlation of dimensions in males accompanies higher negative correlation coefficients of dimension x with index y/x.

The data on young trout deal with periods when growth changes complicate the phenomenon of lag. The changes in correlation coefficient of dimension x with index y/x at different stages of growth may reflect a trend in changes in body proportions during growth.

In 1906 Pearl pointed out that in paramecium there is a "sensible correlation between the absolute size of the body and its shape as measured by length-breadth index." (Biometrika, 5:66, 70, 1906-1907). In series B breadth lags upon length more than length upon breadth. In the other series lag of length on breadth is greater than lag of breadth on length. In the turkey hen body length is accelerated on all dimensions except wing length and head width. All dimensions lag on body length. Data on the turkey hen show that neither the sign nor the value of the coefficient of correlation of absolute weights of organs gives any intimation of presence or absence of lag or of its value. Dimensions show much more consistent lag than do weights.

In male and female frogs weight of each organ is accelerated upon body weight except in the case of spleen; whereas body weight lags approximately 50 per cent upon weight of each organ. The only other instances of acceleration are of spleen on digestive tract, and of digestive tract on kidneys. Otherwise the least amount of lag is shown in liver on kidneys; digestive tract and liver on each other; and liver and pancreas on each other. There are possibly sex differences in variability and correlation in frogs. The above results should be interpreted with that possibility in mind.

In male turtles, weight of liver and spleen is accelerated upon body weight. In every other instance there is less lag of weight of organ on body weight than of body weight on weight of compared organ--as also in the case of frogs. Comparison of lags in paired organs in turtles and frogs shows that though the lags differ in the two animals, the ratio of lags of paired organs is similar in the two animals in most cases. The number of turkey hens is so small (12) that little assurance can be given the specific findings. In Nebraska muskrats skull weight is accelerated on mandible weight, but lags on each recorded weight of long bones; the latter neither lag nor accelerate on skull weight.

SUMMARY

Anatomic lag, the lag of one dimension on another against which it is plotted, is exhibited by most dimensions in man and appears to be a characteristic of the animal kingdom, if the samples from various orders and genera given above are representative.

Lag has differential values for paired dimensions, as, for example, lag in head length-head breadth. Certain dimensions, as leg length-arm length, show little lag. The phenomenon applies not merely within a group but also between groups of similar racial composition, and therefore has intergroup application. It seems also to have interracial application, that is, to apply to means of racial groups. There appear to be sex differentials in lag.

During growth there is differential in lag in dimensions at most age levels.

The relative regression coefficient is perhaps the best measure of lag for comparative purposes and facilitates prediction of values of paired variables. The ratio of relative regression coefficients of paired variables provides a convenient expression of ratio of lag of the two and facilitates comparison of relative lag in paired variables of different series. Further analysis of relative regression coefficients and their ratios should provide a profitable comparative study of lag.

THE EFFECT OF IMPROVEMENT IN NUTRITION ON THE MENTAL CAPACITY OF YOUNG CHILDREN

LOUISE E. POULL[1]

The influence of malnutrition in retarding mental development in infancy and early childhood is a subject worthy of serious consideration. Mental activity is a form of energy and the expression of mental capacity depends upon mental energy and mental effort. Mental capacity itself is dependent upon the development of the brain cells and these as well as other parts of the body must be nourished in order to attain their normal growth.

It has been shown by experiments on rats that normal rats are far superior in their learning ability to rats which have been deprived of Vitamin B during their nursing period (1, 2, 3, 4). Rachitic children compared with non-rachitic children, carefully paired, in the ages of 12 months, 18 months and 24 months show a lower developmental rating (6).

The difficulty in formulating a study of this type with human subjects lies in the fact that reliable mental records of malnourished or undernourished young children are rarely available in numbers sufficient for scientific analysis. If malnutrition is complicated by other factors which tend to retard mental growth, the case is valueless for a study of the effect of malnutrition. Loss of mental control through epilepsy, meningitis, encephalitis, paralysis, glandular dysfunction and the like is not calculable in terms of constants. These diseases often are accompanied by malnutrition, and institutional files abound in records showing these complications.

When records are available, there must be an interval of nutritional care, and a re-test to note changes in mental status. Another requirement is a control group of children of a normal nutritional status at the time of the first test with a record of normality in this respect in the interval and at the time of the re-test.

The method used in gauging nutritional changes is also of primary importance. The age-height-weight index has large variations within year levels and large overlappings in the different year levels. So called "slender types" often have medical diagnoses of good nutrition. Correlations based on this method are therefore apt to be lowered.

In a study made at the New York City Children's Hospital in 1923, based on the age-height-weight index (5), the correlation between change in nutritional index and change in I.Q. was -.226 ± .102. This study was based on records of 40 boys ranging in age from 3 years and 8 months to 15 years 7 months. The intervals between measurements ranged from 2 months to 4 years, 2 months. Age and time interval did not appreciably affect the correlation. Inspection of the data, however, shows that 21 of the 40 boys were over 10 years of age and that only 7 were below 8 years of age. It may well be that the negative finding is due not only to the overlapping of nutritional criteria but to the age of the subjects. Mental control is conditioned not only by physical energy but by social and educational adjustment. Children committed to institutions are frequently maladjusted, coming as they do from intolerable situations in home and school environments. Negative self-feeling is engendered by association with brighter children, secret worries about domestic conditions or about their own disabilities are apt to preoccupy their minds. Bad mental habits have been formed in avoiding the struggle with tasks beyond their mental scope. Before the mind can function at its best each of these individual adjustments must be brought about. The degree of adjustment required and the success in adjustment are variables that cannot be held constant by statistical methods and

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they tend to vitiate statistical findings.

In the earlier years of life social consciousness is still comparatively undeveloped and conflicts have not been established in the same degree. Control factors are present, however, in many cases and must be taken into consideration in the selection of cases. Hyperactivity and wilfulness lower the results of many a mental test.

Investigations of nutrition in relation to scholarship records show positive findings in favor of better nourished children. These studies have no direct bearing on the present investigation as they do not take into consideration the developmental factors of early childhood. They do indicate that the mental energy and mental effort required for successful school work and for response to mental tests is heightened by good nutrition (6, 7, 8).

The procedure in the investigation here reported is to have two groups: Group I, malnourished at the time of the first test and well nourished at the time of the second test. Group II, well nourished at the time of the first test and still well nourished at the time of the second test, the diagnosis of good nutrition and malnutrition to be based on the physicians' statements in the record.[2] Doubtful cases or cases complicated by lack of mental control or enervating factors as described in the introduction are excluded. The two groups are to be equated as nearly as possible for chronological age, I.Q., and interval between tests. The chronological age limit at the upper ends is 7 years, 11 months. Ideally the lower limit should be at 6 months but as admission to the institution is rarely below age 2 years this condition is impracticable.

The tests used for both groups are Kuhlmann-Binet or Stanford-Binet. Cases in which these scales are not applicable are excluded in order to avoid the inaccuracies resulting from the differences in variability of performance scales.

Table 1 gives the range, average, and standard deviation of the two groups in age and I.Q. at the time of the first test, the interval, and I.Q. changes.

TABLE 1

GROUP I	41 CASES		MALNOURISHED
Age	Range 2 yrs. 1 mo. to 7 yrs. 10 mos.	Average 3 yrs. 10 mos.	σ 1 yr. 5 mos.
I.Q.	22 to 82	45	16
Interval	8 mos. to 7 yrs. 0 mos.	3 yrs. 7 mos.	1 yr. 6 mos.
I.Q. change	-8 to +44	+10	12
GROUP II	41 CASES		WELL NOURISHED
Age	Range 2 yrs. 7 mos. to 7 yrs. 7 mos.	Average 4 yrs. 10 mos.	σ 1 yr. 5 mos.
I.Q.	22 to 88	52	19
Interval	8 mos. to 8 yrs. 9 mos.	3 yrs. 4 mos.	2 yrs. 1 mo.
I.Q. change	-20 to +11	-0.3	6

Table 2 gives the intercorrelations of the two groups by the Pearson Product-Moments method.

The outstanding findings in this study are:

a) The average rise of 10 points in I.Q. for Group I who were definitely malnourished at the time of the first test, and well nourished at the time of the final test, in contrast to the average zero change in Group II who were well nourished throughout the period under consideration. The greater variability shown by a standard deviation of 12 points I.Q. in Group I against a standard deviation of 6 points I.Q. in Group II is probably due to the varying degrees of initial malnutrition and of improvement in nutrition. In the absence of reliable numerical measures of these factors a high variability in I.Q. rise is to be expected. The significance of the difference in I.Q. change, in favor of the malnourished group, $\left(\frac{D}{\sigma \text{ diff.}}\right)$ is 2.43, indicating that the chances are 99.2 in 100 that the difference is greater than zero.

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[2] Case reports of the New York City Children's Hospital contain progress records each covering a period of three months. Physical, mental, and behavior changes are recorded from the observations of doctors, nurses, and teachers.

TABLE 2

	Group I		Group II	
	r	P.E.$_r$	r	P.E.$_r$
Age at 1st test vs. I.Q. rise	-.56	± .08	-.003	± .106
I.Q. at 1st test vs. I.Q. rise	-.199	± .10	+.025	± .106
Interval vs. age	-.098	± .10	-.210	± .102
Interval vs. I.Q. rise	+.221	± .102	-.034	± .106
Age vs. I.Q.	+.23	± .102	-.007	± .106

b) The significant correlation between age at the time of the first test and I.Q. rise. The correlation of -.56 is a clear indication that the younger the malnourished child when nutritional care is begun, the greater is the chance of improvement in mental capacity. This correlation would be markedly raised if it were based on a normal age distribution instead of a limited section of the normal distribution.

The two groups are not perfectly equated. The average age of the well nourished group is 1 year and 3 months higher than that of the malnourished group. There were no 5 year olds in the malnourished group, and only 7 cases above 4 years in that group. The determination of the age level at which nutritional care becomes ineffective in raising the mental capacity, is therefore not within the scope of this study.

However, the sharp decline in the average I.Q. rise of the malnourished group after the age of 3 years (see Table 3) raises this question: To what degree is the harm done by malnutrition irreparable after the age of 4 years? The indication from our small number of cases above age 4 years is that only slight gains are to be expected.

TABLE 3

I.Q. CHANGE BY AGE

Age	Group I Malnourished		Group II Well nourished		
	No. of Cases	Average I.Q. Change	No. of Cases	Average I.Q. Change	Difference
2	11	+13	5	+2.4	+10.6
3	15	+14.4	7	-2.85	+17.25
4	8	+ 5.3	10	-1.8	+ 7.1
5	0	-----	8	+1.6	------
6	5	+ 1.6	9	-0.77	+ 2.37
7	2	+ .5	2	+1	- .5

The slightly positive correlation (-.22 ± 10) between length of interval and I.Q. rise in the malnourished group as compared with the zero correlation in the well nourished group raises the question of the minimum interval required to bring about a rise in brightness. Our correlations are based on the I.Q. changes from the first to the final test. Within this period our subjects were re-tested at various times, so that we are enabled to show the gains at progressive intervals. (See Table 4).

TABLE 4

I.Q. CHANGE FROM 1ST TO 2ND TEST

Interval	No. of Cases	Average I.Q. Change	Range
6 mos. to 11 mos.	11	+ 5.6	- 4 to +20
12 mos. to 18 mos	12	+ 6.8	0 to +26
19 mos. to 25 mos.	7	+10.7	- 2 to +28
26 mos. to 32 mos.	6	+11.3	0 to +23
33 mos. to 5 yrs.	5	+ .6	-10 to + 9

The number of cases is too small for reliable generalization but the indication is that a period of 18 months to 2 years is required to bring about the average gain from nutritional care. The large range in each interval shows the variability in this respect.

In 9 cases there was a progressive rise in I.Q. following the rise from the first to the second test. In 7 cases there was no further rise after the second test although observations covered many years. Only 3 children, who were under observation for a number of years, showed slight drops in the second test to be followed by subsequent large gains. In these 3 cases the interval from first to second test was below 1 year. These figures have only a limited value as the periods of observation were determined by the time children remained in the institution, and the intervals between tests depended largely on demands made on the laboratory in other institutional case work.

Studies of 5, 6, and 7 year old children in malnourished and well nourished groups, of children below 2 years and 3 and 4 year groups selected outside of institutions and of higher mentality at the first test would serve to clarify this problem.

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THE RELATION OF ORDER OF BIRTH TO OTHER BIRTH FACTORS[1]

HYMAN GOLDSTEIN[2]

INTRODUCTION

The question of the relative superiority of the different birth orders has been discussed and re-discussed for many years and the solution is not yet in sight. Since heredity and post-natal environment cannot theoretically and plausibly account for any superiorities or inferiorities present at birth so as to produce, on the average, a favorable or unfavorable effect on any particular birth rank, attention has naturally drawn to the pre-natal environment. The problem of the temporal relations in the birth sequence and the problem of whether the more healthful intra-uterine environment is a young one or one more advanced in years are, it seems, inextricably entangled. "The incidence of a trait in a given birth order or its average value on a quantitative scale may involve joint contributions from mother's age and from birth order acting as independent variables. These factors may vary in relative force, at different ages, at different birth positions, and in different social groups" (17). It is, therefore, necessary to separate the effects of one from the effects of the other.

It is the problem of this study to attempt to isolate statistically the separate effects of the ordinal position in the birth sequence and the age of the mother upon such factors as duration of pregnancy, number of antepartum complications, duration of labor, number of labor complications, type of delivery, and birth weight of infant.

The records of the Sloane Maternity Hospital in New York City were utilized.[3] Those cases were considered who had had two or more confinements resulting in live births at the hospital so that comparative data might be secured. In the study the ordinal number for birth order is based on the number of pregnancies, thus counting the number of children born living, stillborn, miscarriages, and abortions. The ordinal number for birth order is thus really the pregnancy order.[4]

Antepartum Complications. Some investigators have stated that the elderly primiparae are more prone to encounter a higher incidence of toxemias, albuminurias, and other complications than the other primiparae (24, 30). Others, however, have reported no relation between the incidence of antepartum complications and mother's age (30).

Some investigators have reported that certain kinds of complaints, such as nausea, vomiting, ankle edema, etc., were more common among primiparae and secundiparae than in the higher multiparae who appeared to complain more of such complications as severe headaches, varicose veins, dyspnea, etc. There was no relation found between parity and number of complaints (19). However, others have studied the question of the relation of birth order to antepartum complications with negative results (10, 35). One study of mothers' reports as to their health during pregnancy and medical records reported no evidence of a relationship between pregnancy order and the health of the pregnant mother (10). However, it has been found that mothers tend to forget the illnesses and disturbances suffered during pregnancy, the injuries received at the birth

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[1] The writer is indebted to Dr. Otto Klineberg and to Dr. Ruth Perl for their constructive criticism of the manuscript.

[2] From New York State Vocational Institution.

[3] The author is indebted to Dr. Benjamin Watson for his kind permission to have access to the material furnishing the data of this study.

[4] Although pre-natal casualties were taken into account in determining the pregnancy order, only the data of live births were utilized in comparisons of pregnancy duration, antepartum and labor complications, labor duration, and birth weight.

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of the child, and the use of instruments at that time (31). Some scientists have felt that although pre-natal conditions might be less favorable to primiparous mothers with a tendency to uncommonly severe toxemias and other disturbances of pregnancy, it is not well-established that this is an important differential factor in handicapping the first-born except at the extremes of the child-bearing period (17).

Duration of Pregnancy. It has been reported that the duration of pregnancy has no relation to mother's age but that it correlates with birth weight rather highly (5, 16, 22). The inferior weight of children of primiparae has been explained in terms of their shorter average duration of pregnancy as compared with those of multiparae (5). However, other investigators have not been able to find any significant differences either in mean length or in standard deviation between first and later pregnancies, (16). No correlation has been found between length of gestation and the duration of first and second stages of labor (1).

Labor Complications. It has been shown that as the age of the primipara increases labor becomes more difficult and dangerous (24, 38), the chief possibilities of complications being rigid soft parts, inefficient uterine contractions, poor engagement of the head or abnormal positions, and minor grades of pelvic contraction (23). In fact, it has been reported that in the elderly primiparae contracted pelves occur two to four times as frequently as in young ones (6). Studies of two groups of primiparae, aged 30-35 years and 36-45 years, showed in the latter group a much greater incidence of premature rupture of the membranes, manual separation of the placenta, and premature labor in addition to some increase in the incidence of breech presentations and eclampsia (33).

Some studies of the relation of mother's age to the incidence of labor complications have reported negative results. It has been found that elderly primiparae do not show any greater percentage of perineal lacerations or labor complications in general than do younger ones (14, 41) although increasing age from 31 through 45 years of age has been reported to bring a greater incidence of weak uterine contractions and uterine inertia (14).

The effect of parity on the incidence of labor complications does not seem to be clear-cut. On the one hand, we find that multiparae have been reported to have less perineal tears, more vaginal outlet relaxations, less strong levator muscles, more cervical tears, and more sub-involutions of the uterus than primiparae (20) while, on the other hand, increasing parity has been reported to bring with it certain changes that gradually increase the risk of childbirth--namely, loss of muscle tone, a tendency to hemorrhage, and calcium depletion (set up by excessive parity) which render the muscles painful, and flabby and enhance the effects due to loss of muscle tone (35). It has been reported that repetition of parturition and lactation, especially when combined with poverty, overwork, and underfeeding, might set up a decalcification of the pelvic bones and cause a shrinkage in the bony birth canal that might react upon the mechanism of labor (35).

Duration of Labor. Some investigators have been able to demonstrate a relationship between mother's age and length of labor. Some have shown that elderly primiparae have shorter labors than young ones (2) while others have shown just the reverse (14, 25, 30, 41). It has been stated by one investigator that this prolonged labor in the elderly primipara is due primarily to the greater incidence of abnormal presentations and inertia uteri whereas the greater elasticity of the soft tissues in the young primipara accounts for her shorter labor. The same investigator felt that irregularities in menstruation and particularly the late establishment of the function seemed in some manner to influence the type and duration of the labor which was, however, uninfluenced by the time of marriage or conception (25).

Other investigators have failed to find any relation between mother's age and duration of labor. Studies of the labors of elderly and young primiparae have failed, in some instances, to show differences in duration (1, 32, 35, 37). In one study, age seemed inversely proportional to labor duration when all cases were considered (that is, no account being taken of parity) but when primiparous and multiparous labors were analyzed separately age lost its significance and apparently had no effect on duration of labor. Neither the weight of the mother nor the weight of the infant seemed to correlate significantly with the duration of labor. Thus the results apparently controverted the beliefs of the long labor of the fat woman, of the elderly primipara, or of the large baby (1).

The effect of birth order on duration of labor has been studied by some investigators. The majority have found that there is a negative relation between parity and duration of labor, that is the primiparae have been found to have longer labors than the multiparae which has been explained by the former's greater resistance of the soft parts (1, 27, 42). However, no significant change in duration was to be noted with increasing multiparity since the decrease in duration was almost entirely confined to the space between primiparae and secundiparae. Although there was no further decrease in the first stage of labor, with succeeding pregnancies there was some shortening of the second stage in multiparae because of decreased resistance of the cervix, vaginal walls, and pelvic floor (1).

Type of Delivery. Elderly primiparae have been found to show a greater incidence of operative delivery, either by forceps or Caesarian section, than younger ones (2, 23, 33, 38) showing progressive increase from 20 through 45 years of age (14, 21, 26) as well as a greater percentage of breech persentations (14).

The incidence of abnormal confinements seems to drop with increasing parity (18). It has been reported that the percentage of operative and instrumental deliveries in primiparae is considerably higher than in multiparae (18, 27, 29). However, following a decrease to an optimal low for the para 4 and 5 groups, there is a steady and rather rapid rise (27). While instrumental delivery occurs most frequently among the first-born it has been found that the use of drugs is more common in the higher pregnancy orders (18).

Birth Weight. Investigators who have found a relationship between mother's age and birth weight have reported conflicting results. On the one hand, some have found a small negative correlation between birth weight and mother's age (18) considering all birth orders; others have found a small negative correlation for the first rank of birth only (22) or have reported that the average birth weight of infants of elderly primiparae was less than that of young primiparae (33). On the other hand, a group of investigators have reported that the older mothers tend to have heavier infants with the highest average birth weight found in infants of mothers aged 25-35 years (3, 4, 7). While it has been found that there exists a slight positive correlation between the age of the mother and the infant's birth weight (7, 11, 41) it cannot be concluded that there is a direct causal relationship between mother's age and the characteristics of the child since there is a positive correlation between birth order and the measurements of the infant and since birth order is closely correlated with mother's age (11, 12).

Some investigators have reported variously that mother's age bears no relation to birth weight (22). Studies of elderly and young primiparae have failed to reveal differences in the birth weights of their infants (25, 32). "The age of the mother bears no decisive influence of its own on the dimensions of the foetus; the increase which is found in these dimensions is simply due to the fact that the greater the age of the mother the greater is the number of previous deliveries, and it follows that if the women married as soon as they were capable of bearing children we should expect, with a rise in the fertility, an increase in these dimensions in the foetuses" (8).

Relatively few studies have shown that the later-born tend to be inferior in weight (34). The majority of studies give evidence that the infants of multiparae tend to be heavier than those of primiparae (4, 9, 39). It has been found that the birth weight increases with order of birth (5, 8, 10, 13, 18, 27, 36, 40) until near the close of the child-bearing period (15). These birth weight differences, of course, are believed to be somatic phenomena which there are no reasons to believe produce any inherited effect (15) or biological inferiority (18). It has been stated by some that the birth weight of a child is an example of a trait in which mother's age and birth order have a joint but unequal influence (17). Other factors have been mentioned as influencing the birth weight. Some have spoken, in this connection, of the mother's weight (5), maternal immaturity and the difficulties incident upon bearing the first child (15), slightly shorter duration of pregnancy of the earlier-born (the first pregnancy might be expected to include not only more children diagnosed as premature, but also more children who are born between the zone of prematurity and normal term) (18), economic status and race of mother (39), sex of infant (39), and interval between successive pregnancies (7).

RESULTS

While the literature cited above deals chiefly with the parity of the mother (the number of foetuses brought to term as live births) the results of this study are mainly concerned with the mother's gravidity (the number of foetuses conceived). Since the parity (order of birth) and the gravidity (order of pregnancy) are closely related the results of this study are comparable to those cited.

The data of the pregnancy records of 205 ward patients were incorporated in this research. In order to take care of the possible divergence in the hereditary factors of different families and to avoid errors due to social selection, the sibling infants of the same mother were compared. All birth orders beyond the fourth were omitted from the study because the number of cases beyond this birth order was too small to encourage statistical reliability. From each record there was ascertained for each pregnancy the parity,[5] gravidity, mother's age, date of last menstruation,[6] date of labor, birth weight of infant, antepartum complications,[7] and labor complications.[7] Both white and colored women were used. No control was made of the following factors in the present research: nationality, race, weight, previous health, temperament, food intake, and activity.

Table 1 presents the duration of pregnancy (in days) comparisons of sibs of the different birth orders. In general, there is no great difference in duration of pregnancy favoring either the younger or elder sibs. The differences are not statistically reliable.

Table 2 shows the duration of labor (in minutes) comparisons of sibs of the different birth orders. In every comparison the younger sibs have the

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[5] In subsequent studies it is planned to investigate the effects of order of birth, mother's age, and natal interval upon such factors as mother's weight at birth, gain in weight and blood pressure variations during pregnancy, and sex of infant.

[6] Hotelling and Hotelling (18) state that there is no perceptible gain in accuracy of estimation of duration of pregnancy by reckoning even from a single coitus of known date, unless of course, the menstruation date is unknown. They believe that it is just as accurate to use the beginning or the last day of the last menstruation.

[7] Antepartum and labor complications were listed by the hospital authorities on a printed sheet. The obstetrician would encircle in each case the particular complication involved. Although every possible complication commonly encountered was listed, there was room left to insert any less common ones that occurred. It is recognized, of course, that although one antepartum complication has been assumed equal in its effect and significance to another antepartum complication and one labor complication also equal to another in this quantitative study, such is probably not the case.

TABLE 1

MEANS, STANDARD DEVIATIONS, COEFFICIENTS OF VARIATION, AND SIGNIFICANCES OF MEAN DIFFERENCES IN DURATION OF PREGNANCY (IN DAYS) OF SIBS N = 375

Birth Order Rel.	N	Older			Younger				Crit. Ratio	Prob.
		Mean	S.D.	C.V.	Mean	S.D.	C.V.	Diff.		
1-2	172	278.6	14.2	5.1	277.5	18.1	6.5	-1.1	.65	74
1-3	45	277.6	12.7	4.6	278.8	15.1	5.4	1.2	.41	65
1-4	11	265.4	16.2	6.1	277.7	22.0	7.9	12.3	1.73	96
2-3	90	279.4	16.2	5.8	280.3	17.7	6.3	0.9	.38	65
2-4	25	282.8	24.5	8.7	282.9	15.9	5.6	0.1	.02	51
3-4	32	275.8	22.0	8.0	277.5	22.1	8.0	1.7	.46	67

TABLE 2

MEANS, STANDARD DEVIATIONS, COEFFICIENTS OF VARIATION, AND SIGNIFICANCES OF MEAN DIFFERENCES IN DURATION OF LABOR (IN MINUTES)OF SIBS N = 375

Birth Order Rel.	N	Older			Younger			Diff.	Crit. Ratio	Prob.
		Mean	S.D.	C.V..	Mean	S.D.	C.V.			
1-2	172	1184.8	670.8	56.6	596.1	413.9	69.4	-588.7	10.65	100
1-3	45	1120.2	581.6	51.9	611.6	369.7	60.4	-508.6	5.24	100
1-4	11	1112.9	904.5	81.3	582.2	505.6	86.8	-530.7	2.08	98
2-3	90	706.9	517.4	73.2	548.7	423.0	77.1	-158.2	2.49	99
2-4	25	625.4	415.9	66.5	491.8	385.4	78.4	-133.6	1.38	92
3-4	32	619.9	389.4	62.8	556.2	394.1	70.9	- 63.7	.79	79

shorter duration of labor and, with two exceptions, the reliabilities are all significant. In every comparison larger coefficients of variation indicate that the later labor durations are more variable. The greatest differences in duration of labor are found when the duration of labor of the first-born is compared with that of later births.

Table 3 shows the birth weight (in grams) comparisons of sibs of the different birth orders. With one exception, the younger sibs show greater birth weight in every comparison. The differences are statistically reliable in three of the six comparisons. In all, save one comparison, the later births have smaller coefficients of variation, indicating less variability in birth weight than shown by their elder sibs. In order to observe the relative effects of increasing intervals between birth orders upon birth weight, all of the 294 pairs of sibs separated by one birth order (such as 1-2, 2-3, 3-4) were compared as were the 70 pairs of sibs separated by two birth orders (such as 1-3, 2-4) and the 11 pairs of sibs separated by three birth orders (such as 1-4). The birth weight differences of sibs separated by one birth order was 92.3 gms., by two birth orders 246.0 gms., and by three birth orders 453.0 gms. This appears to be evidence of a geometric relationship.

TABLE 3

MEANS, STANDARD DEVIATIONS, COEFFICIENTS OF VARIATION, AND SIGNIFICANCES OF MEAN DIFFERENCES IN BIRTH WEIGHT OF INFANT (IN GRAMS) OF SIBS N = 375

Birth Order Rel.	N	Older			Younger			Diff.	Crit. Ratio	Prob.
		Mean	S.D.	C.V.	Mean	S.D.	C.V.			
1-2	172	3222.0	458.7	14.2	3370.9	463.4	13.7	148.9	4.08	100
1-3	45	3170.2	493.8	15.6	3475.0	496.1	14.3	304.8	4.68	100
1-4	11	2862.5	561.6	19.6	3315.5	461.0	13.5	453.0	2.68	99
2-3	90	3366.2	525.3	15.6	3418.7	515.3	15.1	52.5	1.07	85
2-4	25	3350.1	619.3	18.5	3492.6	544.2	15.6	142.5	1.51	93
3-4	32	3493.1	400.9	11.5	3393.2	624.9	18.4	-99.9	.94	83

When all of the sibling pairs in the first four pregnancy orders are considered, the birth weight data available for 375 pairs of earlier-versus later-born siblings indicates that in 38.4 per cent[8] of the pairs the earlier-born are heavier and in 60.8 per cent the later-born are heavier while in 0.8 per cent the birth weights are the same.

Table 4 presents the averages, standard deviations, and coefficients of variation of all the 614 births for birth order, mother's age, duration of pregnancy, duration of labor, and birth weight. The greatest variability occurs in duration of labor wheras the least occurs in duration of pregnancy.

TABLE 4

AVERAGES, STANDARD DEVIATIONS, AND COEFFICIENTS OF VARIATION OF ORDER OF BIRTH, MOTHER'S AGE AT BIRTH, (IN MOS.) DURATION OF PREGNANCY, DURATION OF LABOR, AND BIRTH WEIGHT

N = 614

	Order of Birth	Mother's Age	Duration Pregnancy	Duration of Labor	Birth Weight
Average	2.04	314.40	278.25	789.68	3332.02
Standard Dev.	.91	59.15	17.54	584.17	501.94
Coeff. of Var.	44.6	18.8	6.3	74.0	15.1

Correlation coefficients[9] were computed between order of birth, mother's age, duration of pregnancy, duration of labor, and birth weight. Partial correlations were computed where the variables order of birth, mother's age, duration of pregnancy, duration of labor, and birth weight were held constant. Tables 5 and 6 present the correlation coefficients obtained. Because of the multiplicity of factors involved the results of the partial correlations will be stressed. Even though the great majority of the correlation coefficients obtained are significant the low degrees of relationship found make it evident that they indicate slight tendencies and should be accepted with caution until further corroboration is reported by other investigators.

TABLE 5

INTERCORRELATIONS BETWEEN ORDER OF BIRTH, MOTHER'S AGE AT BIRTH, DURATION OF PREGNANCY, DURATION OF LABOR, AND BIRTH WEIGHT

N = 614

	Mother's Age	Duration of Pregnancy	Duration of Labor	Birth Weight
Order of Birth	+.35	-.02	-.36	+.15
Mother's age		+.25	-.25	+.20
Duration Preg.			-.15	+.18
Duration Labor				+.19

When the effects of mother's age are held constant there is a low negative correlation (-.12) between order of birth and duration of pregnancy and hence tends to conceal the true negative relation between order of birth and duration of pregnancy. It would appear then that the uncontrolled factor of mother's age complicated and distorted the results of Table 1. There is an appreciable negative correlation (-.35) between order of birth and duration of labor which is relatively unaffected by the other variables. This confirms the results of Table 2. There is a low positive relation (+.11) between order of birth and birth weight which is also relatively unaffected by the other variables.

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[8] This figure agrees well with that of Jones and Hsiao (18) who found that in 39 per cent of 639 pairs of earlier-versus later-born sibs the earlier-born were heavier.

[9] All coefficients of .12 or above are significant since they are four or more times their P.E. when N= 614.

TABLE 6

INTERCORRELATIONS BETWEEN ORDER OF BIRTH, MOTHER'S AGE, DURATION OF PREGNANCY, DURATION OF LABOR, AND BIRTH WEIGHT WITH ONE OR MORE OF THESE VARIABLES PARTIALLED OUT N = 614

Legend: 1 = birth order 3 = duration pregnancy
2 = mother's age 4 = duration of labor
5 = birth weight

r = +.35 12	r = -.02 13	r = -.36 14	r = +.15 15	r = +.25 23	r = -.25 24	r = +.20 25	r = -.15 34	r = +.18 35	r = +.19 45
r = +.37 12.3	r = -.12 13.2	r = -.30 14.2	r = +.09 15.2	r = +.28 23.1	r = -.14 24.1	r = +.16 25.1	r = -.17 34.1	r = +.18 35.1	r = +.26 45.1
r = +.29 12.4	r = -.08 13.4	r = -.36 14.3	r = +.15 15.3	r = +.22 23.4	r = -.22 24.3	r = +.17 25.3	r = -.10 34.2	r = +.14 35.2	r = +.25 45.2
r = +.33 12.5	r = -.05 13.5	r = -.40 14.5	r = +.24 15.4	r = +.22 23.5	r = -.30 24.5	r = +.26 25.4	r = -.19 34.5	r = +.22 35.4	r = +.23 45.3
r = +.32 12.34	r = -.16 13.24	r = -.31 14.23	r = +.11 15.23	r = +.27 23.14	r = -.10 24.13	r = +.12 25.13	r = -.14 34.12	r = +.11 35.12	r = +.29 45.12
r = +.36 12.35	r = -.13 13.25	r = -.33 14.25	r = +.18 15.24	r = +.26 23.15	r = -.19 24.15	r = +.21 25.14	r = -.23 34.15	r = +.23 35.14	r = +.30 45.13
r = +.25 12.45	r = -.14 13.45	r = -.41 14.35	r = +.25 15.34	r = +.17 23.45	r = -.27 24.35	r = +.23 25.34	r = -.15 34.25	r = +.18 35.24	r = +.26 45.23
r = +.28 12.345	r = -.17 13.245	r = -.35 14.235	r = +.20 15.234	r = +.23 23.145	r = -.15 24.135	r = +.16 25.134	r = -.18 34.125	r = +.16 35.124	r = +.31 45.123

This confirms the results of Table 3.

There is a low positive correlation (+.26) between mother's age and duration of pregnancy which is not much affected by the other variables. When the effects of order of birth and birth weight are partialled out the original correlation of -.25 between mother's age and duration of labor drops to -.15 indicating that the original correlation was high because of the high negative correlation between order of birth and duration of labor. It would appear then that the major cause of a decreasing duration of labor with an increasing birth order is primarily due to the effects of the repeated births and not necessarily to mother's age. There is a low positive correlation (+.12) between mother's age and birth weight which is relatively unaffected by the other variables. It will be recalled that the correlation between order of birth and birth weight is of about the same magnitude (+.11), indicating that the relation between birth weight and either order of birth or mother's age is no greater in one case than in the other.[10] In passing it is interesting to note the appreciable positive correlation (+.31) between duration of labor and birth weight, indicating the physical difficulties of the birth of larger infants.

Table 7 shows how the percentage of spontaneous deliveries increase from the first to the fourth birth order and how the percentage of instrumental deliveries decrease with increasing parity. The first birth order shows the great-

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[10] The value of the regression equation is twofold: (1) In its usual form, it gives the weights to be assigned to each of several independent variables in order that X_1 (the dependent variable) may be predicted or forecasted with minimum error. (2) In its "special" form the regression equation may be used to analyze within certain limits --- a given capacity or ability. In the "special" form the sigmas of all of the different tests or variables are taken as equal. This procedure eliminates differences in the size of the test or measuring units as well as differences in "spread" or variability and enables us to determine (from the correlation alone) the relative weight with which each independent factor "enters into" or contributes to the dependent variable (the criterion) independently of the other factors. In this way an analysis can be made of the importance of several different factors in some final result. It is very important to remember, however, that in its special form, the regression equation cannot be used for forecasting. (Cf. H. E. Garrett, Statistics in psychology and education. Longmans, Green Co., 1931, page 254). In order to determine from the correlations above the relative weights with which order of birth, mother's age, and duration of pregnancy "enter into" or contribute independently to the birth weight, a regression equation in its "special form" was constructed for this analytical purpose. It was found that all three "enter" about equally and are thus equally important in determining the birth weight. The regression equation constructed was:

$$X_1 = .12\, X_2 + .13\, X_3 + .11\, X_4 + K$$

where X_1 is birth weight, X_2 is birth order, X_3 is mother's age, X_4 is duration of pregnancy and K is a numerical constant.

TABLE 7

PERCENTAGES OF EACH TYPE OF DELIVERY BY ORDER OF BIRTH
N = 614

Order of Birth	N	Spontaneous per cent	Instrumental per cent
1	195	66.2	33.8
2	246	89.0	11.0
3	127	92.1	7.9
4	46	95.7	4.3
Average		82.9	17.1

est incidence of instrumental delivery. The greatest increase in spontaneous deliveries (and hence the greatest decrease in instrumental deliveries) is found between the first and second birth orders.

Table 8 shows essentially the same results as Table 7 except that the sib pairs of the same families are compared thus holding constant the hereditary and social selection factors. In every comparison, with one exception, the younger sibs (later-born) have the greater percentage of spontaneous deliveries and the smaller percentage of instrumental deliveries. However, in only 2 of the 6 comparisons are the differences reliable.

TABLE 8

PERCENTAGES OF EACH TYPE OF DELIVERY BY COMPARISON OF SIBS
N = 375

Birth Order Relation	N	Spontaneous per cent					Instrumental per cent				
		Older	Younger	Diff.	Crit. Ratio	Prob.	Older	Younger	Diff.	Crit. Ratio	Prob.
1-2	172	64.0	90.1	26.1	6.07	100	36.0	9.9	26.1	6.07	100
1-3	45	77.8	93.3	15.5	2.15	99	22.2	6.7	15.5	2.15	99
1-4	11	100.0	100.0	0.0	.00	0	0.0	0.0	0.0	.00	0
2-3	90	88.9	95.6	6.7	1.72	96	11.1	4.4	6.7	1.72	96
2-4	25	92.0	96.0	4.0	.60	73	8.0	4.0	4.0	.60	73
3-4	32	87.5	93.2	5.7	.78	78	12.5	6.8	5.7	.78	78

Table 9 presents the percentages of abnormal births for the different pregnancy orders. The percentage of abnormal births decreases from the first to the fourth pregnancy order. The greatest percentage of miscarriages, stillbirths, and abortions occurs in the first pregnancy order.

TABLE 9

PERCENTAGES OF ABNORMAL BIRTHS CLASSIFIED ACCORDING TO PREMATURES, MISCARRIAGES, ABORTIONS, AND STILLBIRTHS IN THE DIFFERENT PREGNANCIES N = 285

Pregnancy Order	Kind of Birth		Prenatal Casualties			Total Abnormal Births
	Normal	Premature	Miscarriages	Abortions	Stillbirths	
1	81.4	1.8	7.1	4.4	5.3	18.6
2	92.7	0.8	2.7	3.8	0.0	7.3
3	93.4	0.0	3.7	2.2	0.7	6.6
4	97.8	0.0	0.0	0.0	2.2	2.2

Table 10 shows the incidence of antepartum complications and of labor complications from the first pregnancy order to the fourth. The percentage of antepartum complications increases while the percentage of labor complications

TABLE 10

INCIDENCE OF ANTEPARTUM AND LABOR COMPLICATIONS BY PREGNANCY ORDER (IN PER CENT) N = 614

Pregnancy Order	N	Antepartum Complications	Labor Complications
1	195	28.7	56.4
2	246	31.7	51.6
3	127	37.8	52.0
4	46	39.1	37.0

decreases from the first to the fourth pregnancy. This might indicate that, with increasing pregnancy order, the individual is becoming more susceptible to the ills of advancing age since she is aging physiologically although, at the same time, the process of reproduction, from a mechanical viewpoint, is becoming more perfected and adapted to its functions. It was found, as stated below, that there was a biserial correlation of +.10 between mother's age and the incidence of antepartum complications. However, the biserial correlation of +.10 between mother's age and the incidence of labor complications tends to show that the decreasing incidence of labor complications in the higher birth orders is a function of factors connected with the number of previous pregnancies rather than with the age of the mother.

Table 11 presents essentially the same results as Table 10 except that the sib pairs of the same families are compared, thus holding constant the factors of heredity and social selection. In every comparison the later-born show the greater incidence of antepartum complications. In only one of the six comparisons is the difference statistically reliable. In order to see the relative effects of increasing intervals between pregnancy orders on incidence of antepartum complications all of the 294 pairs of sibs separated by one pregnancy order were compared as were the 70 pairs of sibs separated by two pregnancy orders and the 11 pairs of sibs separated by three pregnancy orders. The differences in incidence of antepartum complications represented by one pregnancy order difference was 7.8 per cent, by two pregnancy orders 8.6 per cent, and by three pregnancy orders 9.1 per cent. This is some evidence of a linear relationship. From Table 11 it is seen that, with one exception, the later-born show less incidence of labor complications in every comparison. The differences, however, are not reliable in any comparison.

TABLE 11

PERCENTAGE OF INCIDENCE OF ANTEPARTUM AND LABOR COMPLICATIONS BY COMPARISON OF SIBS N = 375

Pregnancy Order Relation	N	Antepartum Complications					Labor Complications				
		Older	Younger	Diff.	Crit. Ratio	Prob.	Older	Younger	Diff.	Crit. Ratio	Prob.
1-2	172	29.1	32.6	3.5	.71	76	57.0	55.8	1.2	.23	59
1-3	45	26.7	31.1	4.4	.46	67	55.6	51.1	4.5	.43	66
1-4	11	18.2	27.3	9.1	.53	70	54.6	36.4	18.2	.87	81
2-3	90	26.7	41.1	14.4	2.06	98	46.7	53.3	-6.6	.89	82
2-4	25	24.0	40.0	16.0	1.23	89	40.0	36.0	4.0	.29	62
3-4	32	21.9	34.4	12.5	1.12	86	43.8	40.6	3.2	.26	60

Table 12 shows the coefficients of contingency computed between the incidence of antepartum complications, labor complications, and instrumental delivery. There appears some small tendency for antepartum complications to go along with labor complications (+.09) and for labor complications to go along with instrumental delivery (+.00). These coefficients are not reliable.

TABLE 12

COEFFICIENTS OF CONTINGENCY BETWEEN INCIDENCE OF ANTEPARTUM COMPLICATIONS, LABOR COMPLICATIONS, AND INSTRUMENTAL DELIVERY
N = 614

	Incidence of Labor Complications	Incidence of Instrumental Deliveries
Incidence of Antepartum Complications	+.09	.00
Incidence of Labor Complications		+.09

Table 13 presents the biserial correlation coefficients between mother's age, duration of pregnancy, duration of labor, birth weight, incidence of antepartum complications, labor complications, and instrumental delivery. The most significant and statistically reliable correlation is between incidence of instrumental delivery and the duration of labor (+.37). There is a slight tendency (+.17) for duration of labor to be associated with labor complications.

TABLE 13

BISERIAL CORRELATIONS BETWEEN MOTHER'S AGE, DURATION OF PREGNANCY, DURATION OF LABOR, BIRTH WEIGHT, INCIDENCE OF ANTEPARTUM COMPLICATIONS, LABOR COMPLICATIONS, AND INSTRUMENTAL DELIVERY
N = 614 COEFFICIENTS OF .10 OR ABOVE ARE SIGNIFICANT

	Incidence of Antepartum Complications	Incidence of Labor Complications	Incidence of Instrumental Deliveries
Mother's Age	+.10	+.10	-.07
Duration of Pregnancy	-.02	+.12	+.14
Duration of Labor	-.02	+.17	+.37
Birth Weight	-.08	[illegible]	+.02

DISCUSSION

Both partial correlations and direct comparisons of sibs of the same family point to shorter labors and greater birth weights of the later-born. Not only are the later-born heavier than the earlier-born but the third born are heavier than the second born and the second born are heavier than the first born. It is not merely a matter of somatically handicapping only the first born but rather a handicapping, in general, of an earlier-born child, be he first, second, third born etc., when compared with a later-born child. There appears to be evidence of geometric relation between differences in birth weight and intervals of birth orders, that is, the birth weight differences of three birth order intervals are about twice as large as those of two birth order intervals and the birth weight differences of two birth order intervals are about twice as large as those of one birth order interval.

Direct comparison of siblings indicates that the later-born have longer pregnancies (not statistically reliable). However, partial correlations which hold constant the mother's age give evidence that order of birth *per se* correlates negatively with duration of pregnancy. It appears then that the positive relationship between mother's age and duration of pregnancy tends to conceal the negative relationship between order of birth and duration of pregnancy when direct comparison of sibs are made.[11] This would tend to show that the two factors, mother's age and order of birth, oppose each other in influencing the duration of pregnancy. However, both mother's age and order of birth correlate negatively with duration of labor.

Order of birth and mother's age are of about equal importance in determining the birth weight of the infant. It would appear then that the greater birth weight of the later-born would not be due alone to any biological changes associated with the age of the mother. With increasing birth order comes a decreased variability in birth weight. "Possibly a certain reproductive 'maturing' may take place, a process that does not result from age but from repeated functioning of the reproductive system. The observed decrease in variability of the later-born then may result from a more uniform reproduction as a result of this process" (20).[12] Functioning and aging may both act together to bring about this "maturing".

The later-born tend to have a greater percentage of spontaneous deliveries, a smaller percentage of instrumental deliveries, a greater percentage of normal births,[13] a smaller percentage of abnormal births, a greater incidence of antepartum complications (a fact which may be due to the increasing age of the mother since a biserial correlation coefficient of +.10 was found between mother's age and incidence of antepartum complications), and a lesser incidence of labor complications (this ties up with the evidence of a decreased duration of labor in the later-born found by direct comparison of sibs and by partial correlations and with the evidence of a positive relation (biserial correlation of +.17) between duration of labor and incidence of labor complications). As mentioned above, the biserial correlation of +.10 between incidence of labor complications and mother's age indicates that the decrease in labor complications in the higher birth orders is a function of factors connected with order of birth and not with mother's age. There is evidence of a relation between birth weight and duration of labor (+.31) and between duration of labor and incidence of instrumental deliveries (+.37) revealing thereby that the birth of larger infants usually takes longer and sometimes necessitates the use of instruments.

SUMMARY AND CONCLUSIONS

1. The records of 285 multiparae were examined at the Sloane Maternity Hospital in New York City for the relationship of order of birth to incidence of antepartum complications, duration of pregnancy, incidence of labor complications, duration of labor, and birth weight.

2. There is a tendency for the later-born to have a greater birth weight. There appears to be some evidence of a geometric relation between differences in birth weight and intervals of birth orders, that is, as the intervals increase arithmetically the birth weight differences increase approximately geometrically.

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[11] This would tend to explain why the studies cited above have failed to find any constant relationship between order of birth and duration of pregnancy or between mother's age and duration of prognancy since factors other than those under consideration might be uncontrolled and thus distort the results.

[12] Locke and Goldstein (20) observed this superiority of the later-born as well as their decreased variability in a study of the intelligence of 1345 pairs of earlier-versus later-born sibs.

[13] Jones and Hsiao (16) compared the incidence of normal births in the sibling pairs of the first five pregnancy orders and found that out of ten possible comparisons eight showed that the later-born had a higher incidence of normal births although the differences were too small to be statistically reliable.

The later-born are less variable than the earlier-born in birth weight. Order of birth and mother's age seem to "enter" equally in determining the birth weight.

3. There is a slight negative relation between order of birth and duration of pregnancy when the disturbing factor of age of mother is held constant. However, mother's age and duration of pregnancy show a positive correlation (+.28) when order of birth is held constant thus indicating that the foetuses of older mothers tend to have longer pregnancies. It is possible that there is some physiological effect in the aging of the mother that makes for longer pregnancies.

4. There is a tendency for the later-born to have shorter durations of labor as shown by a correlation of -.35 between order of birth and duration of labor when mother's age, birth weight, and duration of pregnancy are held constant. There is a slight negative correlation (-.15) between mother's age and duration of labor when the other variables are partialled out.

5. The later-born tend to have a greater incidence of antepartum complications but a lesser incidence of labor complications, although the differences are not statistically reliable.

6. The later-born tend to have a greater percentage of spontaneous deliveries and a greater percentage of normal births. These differences, while *favoring the later-born, are not statistically reliable in every comparison.*

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A STUDY OF COMMON MOTOR ACHIEVEMENTS AT THE PRESCHOOL AGES

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INTRODUCTION

The object of this experiment was to study some common motor achievements of children at the preschool ages in an effort to discover (1) the stages of development in selected motor achievements, (2) the sequence of development of these stages, (3) the interrelationships of these motor achievements, and (4) their relationship to sex and to ascendance scores.

The tests devised were given to ninety-eight children in the preschool laboratories of the University of Iowa. These tests were designed to provide means of discovering the motor development of children from two to six years of age by utilization of normal activities. The selected activities were: ascending and descending ladders, ascending and descending steps, hopping, skipping, jumping, balancing on path and circle, ball throwing, ball catching, and ball bouncing.

Preliminary observation and testing were carried through in order to determine what the stages of performance were. The objective was to record the stages which clearly differed one from the other. How they line up in regard to age progress is the ultimate end of the study.

Bayley (1) made a *seriatim study of sixty-one children, testing these* children from infancy up to three years of age. She says, "There remains the possibility that the motor functions measured during the first three years are actually less discreet and independent than are the motor skills measured at later ages. If this is true, we may find that a gradual increase in the functional independence of motor skills will continue for some time after the age of three years." (1, p. 10) One purpose of the present study is to discover the increase of motor skills into the four-, five-, and six-year levels.

METHOD OF PROCEDURE

It was the idea from the beginning to keep each activity in the test situation as simple as possible so that it could be reproduced easily. For the ball throwing and ball bouncing a "location field" was devised for determining the distance and direction of the child's throw or bounce. This field was made of heavy brown paper 8 feet wide and 17 feet long, with a 4 inch strip of wall board at each end to anchor it. The width was marked off into zones. Zone 1 was 2 feet in width and extended down the center of the field, with zones 2, 3, and 4, each 1 foot wide, to the right and left of zone 1. The length was marked off into distances; distance 1 was 3 feet in length and distances 2, 3, 4, 5, 6, 7, and 8 each 2 feet in length. For the throw or bounce the child stood at the edge of and on the center line of the field and threw or bounced the ball to the experimenter at the opposite end of the field. The results were recorded according to zone and distance and the child's use of one or both hands.

In the catching series the ball was thrown to the child at a level with his chest each time, as nearly as was possible. The method used in the attempt to catch the ball, the successes, and whether or not the child used defense movements when the ball was tossed to him were all recorded. Two balls were used throughout, one 16-1/4 inches in circumference, the other

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[1] From the Iowa Child Welfare Research Station, University of Iowa. The writers wish to thank Miss Dorothy E. Bradbury for help in condensing the material for this article.

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9-1/2 inches. Three trials were given for each performance with each ball.

To determine the child's ability to maintain equilibrium and balance, a walking path and a circle were used. A demonstration was given in each case. If the child failed to respond, he was asked to follow the experimenter as she walked on the path or circle. The path, 10 feet long and 1 inch wide, was drawn on a large piece of brown paper and colored red. The circle was cut from wall board and was 4 feet in diameter. A strip (1 inch wide) was drawn around its outer border and colored red like the path. The number of times the child stepped off the path and circle on each trial was recorded. Three trials were given on each. If the child set one foot off the line for balance but did not take a step, he was not penalized.

Four heights were used for the jumping--boxes 8, 12, 18 and 28 inches in height. The child was given three trials at each height and was checked according to the method he employed in the jump.

The child was asked to hop on one and on both feet and a demonstration of each was given him. He was given three trials at each. The stages were recorded in number of steps. Four items were listed under skipping: walking, shuffle, skipping on one foot, and skipping on alternating feet. The experimenter skipped and asked the child to follow her. The shuffle has a rhythmic quality--the same foot is always forward at each advance. It is definitely in advance of walking and is not the same high step the children employ in galloping.

Both ascending and descending steps were tested on short and long flights. The short flight had 4 steps 7 inches in height with an 11 inch tread. The long flight had 11 steps of the same height and tread. The rail on both flights was 29 inches in height. The steps on which the kindergarten children were tested were slightly different. The short flight had 4 steps 7 inches in height with a tread of 10 inches and the long flight 12 steps 8-1/4 inches in height with a tread of 11-3/4 inches. The hand rail was 34 inches above the steps. The child had three trials on ascending and descending both flights of steps.

For ladder climbing two ladders were used. One had twelve rungs 6 inches apart, the other six rungs 12 inches apart. The ladders were placed at approximately a 45 degree angle each time. This placement was kept constant by placing the same ladder rung against the support each time.

TREATMENT OF DATA

Scoring

Scores were assigned the various stages of each skill according to their difficulty of performance as evidenced by the percentage of children at each age who accomplished them. They are shown in the section on Motor Age Assignments. The term "mark time" in ascending and descending steps and ladders was applied to bringing one foot to the level of the other and stopping instead of moving past as is done in alternating. "With support" meant holding to the rail. In the ball throwing series all trials fell in zones 1 and 2. Since those which fell in zone 2 were often the result of attempting to use a superior method, the final score on throwing was based on distance alone.

Partial Score Groupings

In order to obtain a range of scores sufficiently large to give significant correlations, the various skills were combined into partial score groups. The items which seemed more similar were grouped together. The resulting combinations were: (1) steps and ladders (ascending and descending long and short flight of stairs, large and small ladders); (2) ball activities (throwing, catching and bouncing large and small balls); (3) jumping (8, 12, 10 and 28 inch jump); (4) hopping, skipping, walking path, and circle (hopping on one foot, hopping on both feet, skipping, walking on path, walking on circle).

These partial scores were then correlated for each sex in order to discover what the quantitative relationship was in each case. The correlations are given in Table 1.

TABLE 1

Measures Correlated	Boys		Girls	
	Number	Correlation	Number	Correlation
Total Group				
Steps and ladders with ball activities	50	.54 ± .10	48	.72 ± .06
Steps and ladders with hopping, skipping, etc.	50	.69 ± .07	48	.79 ± .05
Ball activities with hopping, skipping, etc.	50	.69 ± .07	48	.74 ± .06
Younger Group (26 to 53 Months)				
Steps and ladders with ball activities	16	.40 ± .21	29	.66 ± .10
Steps and ladders with hopping, skipping, etc.	16	.72 ± .12	29	.72 ± .09
Ball activities with hopping, skipping, etc.	16	.69 ± .13	29	.75 ± .08
Jumping Series (Boys, 26 to 53 months; girls, 26 to 48 months)				
Jumping with steps and ladders	16	.72 ± .12	21	.79 ± .08
Jumping with ball activities	16	.81 ± .07	21	.74 ± .11
Jumping with hopping, skipping, etc.	16	.77 ± .08	21	.84 ± .07

The correlations between these various groups of skills are high and have a wide spread, from .40 to .84. This is contrary to the findings reported by previous studies of motor development. In the present study the correlations are affected to some extent by the age range. The total group ranges in age from two to six years.

Because of the fact that after the age of forty-eight months for the girls and fifty-three months for the boys the scores on the jumping series were practically perfect throughout, the correlations were run on this series only up to those ages. The correlations between the jumping series and each of the other groups are high, ranging from .72 to .84.

With two exceptions (the correlations between the jumping series and ball activities, and between steps, etc., and hopping, skipping, etc.) all the correlations for the girls are higher than those for the boys.

Since there was a large scattering of perfect scores in the two upper age groups, correlations were run for both sexes on the three lower age groups separately. The ages in these ranged from twenty-six to fifty-three months. The correlation between steps, etc., and ball activities for the boys is .40, the lowest correlation in any of the groupings. The corresponding correlation for the girls is .66. The other correlations of the series were not much affected by the reduction in age range. This indicates that there is a high correlation between the groups of skills and that the wide age range is not entirely responsible for the high correlations obtained in the total group series.

As a further check on this point, there is need for correlations within still narrower age ranges. For this reason correlations were run on age group forty-two to fifty-three months for the twenty girls. This was the only age and sex group large enough to give significant results. The correlations for girls are as follows: Steps, etc. with ball activities, .32 ± .17; Steps, etc. with hopping, etc., .32 ± .17; Ball activities with hopping, etc., 20 ± .10.

With this very narrow age range and small number of cases, the correlations are noticeably reduced.

TABLE 2

Months	Number	Mean	Standard Deviation	Standard Error
		Steps and Ladders		
30 to 41	13	19.5	5.53	1.53
42 to 53	26	23.6	5.18	1.02
54 to 65	28	28.0	3.37	.64
66 to 74	25	29.7	3.33	.67
		Ball Activities		
30 to 41	13	14.2	4.47	1.24
42 to 53	26	23.1	4.89	.96
54 to 65	28	26.5	5.28	.99
66 to 74	25	30.8	5.21	1.04
		Jumping		
30 to 41	13	7.2	2.58	.71
42 to 53	26	11.0	1.27	.25
54 to 65	28	11.7	.88	.17
66 to 74	25	12.0	.00	.00
		Hopping, Skipping, etc.		
30 to 41	13	5.2	3.25	.90
42 to 53	26	13.2	10.58	2.07
54 to 65	28	14.2	7.34	1.39
66 to 74	25	15.5	18.26	3.65
		Totals		
30 to 41	13	46.2	10.63	2.94
42 to 53	26	70.9	10.58	2.08
54 to 65	28	81.4	7.34	1.38
66 to 74	25	84.0	18.26	3.65

Means, Standard Deviations, and Critical Ratios on Partial Scores

The means, standard deviations, and standard errors for each age group, except the two-year-old group, on all partial scores are given in Table 2. The two-year-old group was too small (six children) for figures on it to be statistically significant.

The maximum score for each partial group is as follows: steps and ladders, 32; ball activities, 53; jumping, 12; hopping, skipping, etc., 17.

The highest possible score for any individual then is 114. The highest score by any child in this study, 102, was made by a boy seventy months of age. The lowest score, 14, was made by a girl twenty-six months of age.

Table 3 gives the critical ratios between age groups on each partial score. These ratios show to what degree of certainty the performance of one age group is significantly different from that of another age group on each partial score. A critical ratio of 3 or more indicates practical certainty that one age group's performance is more advanced than that of another age group.

The ratio between the three- and four-year-olds on the partial score for steps and ladder is 2.20 (98 chances in 100 that the true difference is greater than zero). In all other comparisons, the four-year-old group is significantly

TABLE 3

Age Groups, Years	Steps and Ladders	Ball Activities	Jumping	Hopping, Skipping, etc.	Total Scores
3 and 4	2.20	5.66	5.08	7.26	6.86
3 and 5	5.59	7.68	6.11	9.06	10.83
3 and 6	6.07	10.22	6.67	10.72	8.06
4 and 5	4.37	2.42	2.13	1.67	4.23
4 and 6	5.02	5.42	3.71	3.34	3.11
5 and 6	.93	3.00	1.72	1.79	.64

superior to the three-year-old group.

It will be noticed that the critical ratio between the five- and six-year-old groups approaches certainty in only one case. Doubtless this is true because by the age of five and six years the children have reached approximately the maximum of ability in the specific motor activities used in this experiment. This assumption is substantiated by the fact that the one case in which the ratio between these two groups is significant is that of the ball activities. Continued progress in the ability to catch, bounce, and throw balls is possible on past the six-year level, whereas by six years all children are alternating without support when ascending and descending steps and have reached a similar level in the other activities.

The ratio between the four- and five-year-old groups on the partial score for ball activities is 2.42. There are 95 chances in 100 here that there is a difference greater than zero. The ratio between those ages in the partial score for the jumping series is 2.13. There are 92 chances in 100 of a significant difference in that case. These ratios may be affected by the relative percentages of boys and girls. There are twenty girls as opposed to six boys in the four-year-old group and ten girls as opposed to eighteen boys in the five-year-old group.

On the partial score for the skipping and hopping series, the ratio between the four- and five-year-old groups is only 1.67. There are only 87 chances in 100 that there is a significant difference. Here again the relative percentage of boys and girls may be effective.

From the total scores it will be seen that there is a significant difference between each two age groups except the five- and six-year-old groups. The ratio here is only .64. The nature of the tests in this study may explain that. It is probably because the majority of the children at the five- and six-year levels have reached approximately maximum ability in the activities used.

Reliability

A total of forty-six retests was given within a week following the original test in each case. The age range of the retest cases was from twenty-seven to seventy-two months. When the total score of the original test was correlated with the total score of the retest, a correlation coefficient of .90 ± .004 was obtained. The activities appealed to the children as normal play situations, they enjoyed the "games", and no particular motivation was necessary; so their performance in each test was normal and represented their level of ability at that time. This and the wide age range probably account for the high correlation.

The percentage of children who did not change scores on each achievement was then figured. Table 4 gives a record of these percentages. They are high, denoting little change except for those of the ball activities and walking the circle. For the ball activities the scoring scheme was more minute and detailed than for any of the other activities so that a greater variation was easily possible, with less actual difference in performance.

The distribution of changes on total scores, expressed in percentages for both boys and girls is given in Table 5.

TABLE 4

PER CENT OF CHILDREN WHOSE SCORES REMAINED UNCHANGED ON RETEST
(27 GIRLS, 19 BOYS)

	Steps and Ladders							
	Ascending Long Steps	Descending Long Steps	Ascending Short Steps	Descending Short Steps	Ascending Large Ladder	Descending Large Ladder	Ascending Small Ladder	Descending Small Ladder
Girls	97	87	100	97	97	93	100	93
Boys	100	90	95	90	95	95	100	100
Total	98	87	98	94	96	94	100	96
	Ball Activities							
	Throw Large Ball	Catch Large Ball	Throw Small Ball	Catch Small Ball	Bounce LargeBall	Bounce Small Ball		
Girls	49	52	97	78	78	82		
Boys	37	48	58	53	74	74		
Total	44	50	81	78	77	79		
	Jumping							
	8 Inches	12 Inches	18 Inches	28 Inches				
Girls	100	97	97	89				
Boys	100	95	95	95				
Total	100	96	96	92				
	Hopping, Skipping, Etc.							
	Hop One Foot	Hop Both Feet	Skip	Walk Path	Walk Circle			
Girls	89	89	100	97	75			
Boys	85	100	100	95	64			
Total	87	94	100	96	70			

TABLE 5

Change	Boys (19)	Girls (27)
No change	.21	.26
1 point	.26	.30
2 points	.26	.15
3 points		.03
4 points	.10	.10
5 points		.03
6 points		.07
7 points		
8 points	.10	.03
9 points		
10 points	.05	

It will be seen that this distribution ranges from no change to 10 points change. Three-fourths of the children have no change or only 1 or 2 points change.

Sex Comparisons

Means and Standard Deviations. Table 6 presents the means and standard deviations for boys and for the girls on each partial score for four-, five-, and six-year-old children. There was an insufficient number of cases in the two- and three-year-old groups to justify division by sex.

Because of the small number of cases comparisons on sex differences can be

TABLE 6

MEAN AND STANDARD DEVIATIONS ON EACH PARTIAL SCORE FOR FOUR-, FIVE-, AND SIX-YEAR-OLD BOYS AND GIRLS

	42 to 53 Months			54 to 65 Months			66 to 74 Months		
Group	Cases	Mean	Standard Deviation	Cases	Mean	Standard Deviation	Cases	Mean	Standard Deviation
Steps and Ladders									
Boys	6	27.17	4.18	18	29.61	2.98	16	29.25	3.80
Girls	20	22.50	4.96	10	27.40	3.56	9	30.44	2.06
Ball Activities									
Boys	6	25.83	4.98	18	27.44	4.26	16	30.94	6.27
Girls	20	22.30	4.56	10	24.70	6.37	9	30.56	2.36
Jumping									
Boys	6	11.67	.74	18	11.56	1.07	16	12.00	.00
Girls	20	10.90	1.34	10	12.00	.00	9	12.00	.00
Hopping, Skipping, Etc.									
Boys	6	12.50	3.73	18	13.67	2.60	16	14.94	1.75
Girls	20	13.30	2.97	10	15.80	1.78	9	16.44	.96
Total									
Boys	6	77.17	10.43	18	82.28	6.44	16	87.13	8.60
Girls	20	69.00	9.87	10	79.90	8.50	9	89.44	3.83

considered only as suggestive. However, the results are quite consistent as between age groups. Boys appear to be somewhat superior on steps and ladders and ball activities and girls on hopping and skipping.

Motor and Ascendant Behavior Score Comparisons

Ascendance scores[2] were available for sixteen of the three-year-old and seventeen of the four-year-old children. The correlation between the motor scores and these ascendance scores for the three-year-old group was .006 and for the four-year-old group .27, indicating that there is little or no relationship between these motor achievements and the ascendant behavior of preschool children.

MOTOR AGE ASSIGNMENTS

Age at par, or motor age, was determined for each stage of development of each skill and the performances arranged in a tabulation according to motor age. This tabulation shows the sequence of development from descending the large ladder by marking time cautiously, credited at twenty-four months, to bouncing the large ball with one hand a distance not greater than three feet, credited at seventy-one months.

Motor age assignments were made according to the midpoint, that is, the point of age in months at which 50 per cent of the children made a given score or better than that score, and the other 50 per cent made less than the given score. This method was based on the assumption that there is an even growth per month in a year interval. These age assignments were figured according to the method devised by Thurstone (4). Thurstone's formula is:

$$\text{Age at par} = y + \frac{.50 - P_1}{P_2 - P_1}$$

P_1 = percentage immediately below 50 per cent
P_2 = percentage immediately above 50 per cent
y = age which has the P_1 correct answers

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[2] The ascendance scores were taken from a study by Page (3), who used the technique worked worked out by Jack (2).

TABLE 7

Months	Score	Item
71	4	bouncing large ball, one hand, distance 1
68	6	catching large ball, elbows at side of body, success on 2 or 3 trials
65	3	bouncing large ball, both hands, distance 3
65	7	throwing small ball, both hands or one hand, distance 7
63	5	throwing large ball, both hands or one hand, distance 5
62	4	descending large ladder, alternate feet, with facility
60	4	hopping on one foot, 10 or more steps
60	3	skipping, alternate feet
57	6	throwing small ball, both hands or one hand, distance 6
56	3	descending large ladder, alternate feet, with caution
55	5	catching small ball, elbows at side of body, no success or success on one trial
55	4	descending long steps, alternate feet, unsupported
55	3	hopping one foot, 7 to 9 steps
53	4	throwing large ball, both hands or one hand, distance 4
53	4	descending small ladder, alternate feet, with facility
52	5	throwing small ball, both hands or one hand, distance 5
51	3	descending small ladder, alternate feet, with caution
51	5	catching large ball, elbows at side of body, no success or success on one trial
50	4	catching small ball, elbows in front of body, success on 2 or 3 trials
49	4	descending short steps, alternate feet, unsupported
48	3	descending long steps, alternate feet, with support
48	3	descending short steps, alternate feet, with support
47	4	ascending large ladder, alternate feet, with facility
46	2	bouncing large ball, both hands, distance 2
46	3	jumping 28 inches, alone, feet together
46	2	hopping one-foot, 4 to 6 steps
45	3	ascending large ladder, alternate feet, with caution
45	3	walking circle, no steps off
44	4	throwing small ball, both hands or one hand, distance 4
44	4	catching large ball, elbows in front of body, success on 2 or 3 trials
43	1	hopping one foot, 1 to 3 steps
43	2	jumping 28 inches, alone, one foot ahead
43	3	throwing large ball, both hands or one hand, distance 3
43	2	skipping on one foot
42	4	hopping both feet, 10 or more steps
41	4	ascending long steps, alternate feet, unsupported
41	3	hopping two feet, 7 to 9 steps
40	2	hopping two feet, 4 to 6 steps
40	5	bouncing small ball, one hand, distance 2
38	2	descending large ladder, mark time, with facility
38	4	ascending small ladder, alternate feet, with facility
38	3	catching small ball, elbows in front of body, no success or success on one trial
38	1	skipping, shuffle
38	1	hopping both feet, 1 to 3 steps
37	2	catching small ball, arms straight, success on 2 or 3 trials
37	3	jumping 18 inches, alone, feet together
37	3	walking path, no steps off
36	1	jumping 28 inches, with help
35	3	catching large ball, elbows in front of body, no success or success on one trial
35	2	walking circle, 1 to 3 steps off
34	2	catching large ball, arms straight, success on 2 or 3 trials
34	2	descending long steps, mark time, unsupported
34	3	jumping 12 inches, alone, feet together
34	3	ascending small ladder, alternate feet, with caution
33	2	ascending large ladder, mark time, with facility
33	3	throwing small ball, both hands or one hand, distance 3
33	3	jumping 8 inches, alone, feet together
31	3	ascending long steps, alternate feet, with support
31	4	ascending short steps, alternate feet, unsupported
31	2	jumping 18 inches, alone, one foot ahead
31	2	walking path, 1 to 3 steps off
30	2	throwing large ball, both hands or one hand, distance 2
29	2	throwing small ball, both hands or one hand, distance 2
29	3	ascending short steps, alternate feet, with support
29	2	ascending long steps, mark time unsupported
28	2	descending short steps, mark time, unsupported
28	1	walking circle, 4 to 6 steps off
28	1	walking path, 4 to 6 steps off
24	4	bouncing small ball, one hand, distance 1
24	2	ascending short steps, mark time, unsupported
24	1	jumping 18 inches, with help
24	2	jumping 12 inches, alone, one foot ahead
24	1	descending large ladder, mark time, with caution

The motor ages are considered tentative and are subject to revision in the future. With the present data it did not seem advisable to refine the computations to decimals of a month.

It was impossible to assign motor ages to some subheads of certain skills because of the fact that the ages included in the study were not sufficiently high, or low, as the case may be.

A comparison of the results obtained on the items in this study which are similar to those of the Bayley (1) study, with the results obtained by Bayley on those items, is interesting:

Bayley found that children could walk up-stairs alone marking time at 24.3 months of age. Her stairs had only two steps and the landing platform. This would be slightly comparable to the short flight of steps in the present study. The age for ascending the short flight marking time unsupported in this study is 24 months.

Bayley found that children descended the steps alone marking time at 24.6 months. Twenty-eight months is the age assigned that skill in the present study. This age might have been lower had the flight of steps been as short as that used by Bayley.

She found that the age at which children could walk on a chalk line 10 feet in length was 31.3 months. She credited the child if he walked near the line, usually stepping on it with one foot, or astride it for the entire length. In this study the child was asked to walk a 1 inch line 10 feet long and was credited according to his ability to stay on the line. The motor age for the lowest score on this skill, four to six steps off, in the present study is 20 months, one to three steps off is 31, and no steps off is 31 months. No steps off in the Bayley study is accredited a motor age of 38,5.

In Bayley's study the motor age for jumping 12 inches with feet together is 37.1 months. In the present study the motor age for this skill is 34 months, and the age for jumping from that height with one foot ahead is 24 months.

Hopping on one foot for two or three hops is given a motor age of 49.3 months in the Bayley study. In the present study the motor age for that skill is 43 months.

In this study the motor age is 48 months for descending the short steps alternating unsupported. Bayley's motor age for this skill is 50 months.

With the exception of descending the short steps alone marking time, the motor ages are slightly lower for each skill in the present study than in the Bayley study. There is agreement in relative placement if not on exact age in the two studies. The agreement is close considering the fact that the number of children at the two-year level in this study was so small.

SUMMARY AND CONCLUSIONS

The purpose of this experiment was to study some common motor achievements of children at the preschool ages.

The activities selected for study were: ascending and descending long and short flights of steps and large and small ladders; catching, throwing and bouncing large and small balls, jumping, hopping, skipping, and balancing on path and circle. Scores were assigned to the various stages of skill in each performance according to their difficulty as evidenced by the percentage of children at each age who accomplished them.

The devised tests were given to ninety-eight children in attendance at the preschool laboratories of the University of Iowa. The age range was from twenty-six to seventy-four months. Of these ninety-eight children, forty-six were retested the week following the original test in order to determine the reliability of the tests. The coefficient of correlation was .98 ± .004. Three-fourths of the children changed less than three points in score.

In order to obtain a range of scores sufficiently large to give significant correlations, the various skills were combined into partial score groups, under (1) steps and ladders activities; (2) ball activities; (3) jumping; and (4) hopping, skipping, and balancing series.

Correlations between these partial scores for each sex, age range two to six years, are high and have a spread from .64 to .79. For the age range of twenty-six to fifty-three months, the correlations range from .40 to .75. The correlations between the partial score for jumping and each of the other partial scores were based on ages twenty-six to forty-eight months. They are high for both girls and boys, .72 to .84. Correlations run on the girls' age group from forty-two to fifty-three months and excluding the jumping series are lower, from .20 to .32. This was a narrow age range and there were only twenty children.

There is a significant gain in ability from one age group to the next, with a few exceptions. On the total score the only exception is between five and six years. The critical ratio between the three- and four-year-olds on the partial score for steps and ladders is 2.20. All other ratios between three- and four-year-olds are significant. The ratio between the four- and five-year-old groups on the partial score for ball activities is 2.42, for jumping 2.13, for hopping, etc., 1.67. These ratios are probably affected by the relative percentage of boys and girls in the groups. The ratio between five- and six-year-old groups approaches significance only on the partial score for ball activities. Here the ratio is just 3.00. The lack of difference on the other skills is explained by the fact that the majority of the children at the five- and six-year levels have reached approximately the maximum ability in the activities used in this study, with the exception of ball activities.

Boys appear to be somewhat superior on steps and ladders and ball activities and girls on hopping and skipping. The number of cases at each age level is small, but the results are quite consistent for the different age groups.

There is little or no correlation between ascendance scores and the motor scores of the three- and four-year-old children used in this study. The age range is from thirty-seven to fifty-nine months for these groups. The correlation for the three-year-old group is .006 and for the four-year-old group .27.

Motor age assignments were made for each stage of each skill according to the point at which 50 per cent of the group fail and 50 per cent succeed. Seventy-three such stages were assigned motor ages. These age assignments are considered tentative and are subject to revision after further testing.

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FEARS: THEIR CAUSE AND PREVENTION

GEORGE LAWTON[1]

Fear is the most universal of human experiences. But while it sometimes leads to a good result: escape from danger, most of the fears of civilized life are totally out of proportion to any danger involved. As such they always reduce efficient adjustments and often ruin lives.

The greatest number of fears arise in childhood in the course of the child's everyday activities. For that reason, adults can do a good deal to prevent fear from entering a child's life, or, to shorten its career, if it already has taken root. Many fears are either wholly avoidable or else can be removed by simple measures when noted early enough.

We sometimes think a person is unafraid because he does not show fear in its typical form, or because, as in the case of a very young child, he cannot say he is afraid. Even an older child who knows the words is not always aware that fear is the cause of his unhappiness, though this is apparent to the adult who has learned to correctly interpret the tell-tale signs of distress.

A fear may be thought of as simple when it is evoked seldom and for a relatively short time, and when it effects only a small portion of the individual's personality, for example, a fear of thunder or lightning. Fears are complex when they are experienced for a long time in an intense form and when, as a result, a considerable part of one's emotional and intellectual life is damaged and everyday activities are handicapped. To dread contact with dirt is an instance of such a fear.

Generally speaking, simple fears are found in children and young people, while complex fears are seen in adults. Fears do not all arise in the same manner and are not to be treated the same way. In order to prevent or remove a particular fear, it is important to learn something about the class to which it belongs.

In what follows, fears are arranged in an order of ever increasing complexity from infancy to maturity.

I

The first type of fear which a human being is likely to manifest are the "conditioned" fears, those which are built upon or associated with instinctive fears. Our discovery of the manner in which they develop makes a dramatic story, the first part of which takes place in Russia some thirty years ago.

Pavlov, the great Russian physiologist, is indirectly responsible for our knowledge of conditioned fears. As a physiologist, he was very much interested in the process of salivation in dogs. An animal would be fed, a certain amount of saliva would be produced and this would be measured. Pavlov noted a strange thing. After the experiment had gone on for a time with a particular dog, the latter's mouth would begin to water as soon as he saw the dish of food, or saw the attendant who brought the food, or even when he heard the attendant's footsteps in the next room. Now, salivation at the taste of food is an automatic reaction or reflex. When such an automatic reaction occurs in the absence of the original stimulus because of something associated with the latter, we get an artificially manufactured or "conditioned" reflex.

Pavlov generated and extinguished such conditioned reflexes in the simplest of ways. He would sound a buzzer and then feed the dog. In the course of several days training, the animal would begin salivating merely at the sound

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[1] From New York City.

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of the buzzer. But the dog could also be "unconditioned". During several successive experiments, Pavlov merely sounded the buzzer and did no more. After a time, the dog stopped salivating at its sound: "no food, no saliva".

The second part of the history of "conditioned" fears takes place in the United States. John B. Watson, the noted American psychologist and founder of the school of psychology called Behaviorism, some years after Pavlov's initial experiments had begun, sought to determine what actions of human beings might be called instinctive. It seemed to him that the only way to attack the problem was to study new-born infants and discover what reactions appeared before any learning had yet taken place. Working with a large number of infants, he concluded that there were only three types of behavior patterns that might be called instinctive or unlearned: fear, rage and love.

It had been generally held that many of the adult's extensive repertoire of fears are inborn. But when Watson went to the nursery to put this belief to the test, he found that infants could be frightened by only two things: the sudden loss of support and a loud sound.

Having ascertained these basic fears, Watson applied to their study Pavlov's discovery of the conditioned reflex. He was able to show that children acquire a great many fears through a process of conditioning, and could be made to lose them through unconditioning. Anything which accompanied the instinctive fears would become associated with them in the infant's mind and thereafter, coming of itself, would be sufficient to arouse the fear reaction. For example, a youngster given a bunny at the time of a crashing sound might then and there develop a fear of furry animals. Another baby, allowed to slip from one's grasp when given a bath, might henceforth be afraid of water.

To be able to treat human beings as Pavlov had treated dogs, to implant fears and then eradicate them, was naturally an exciting prospect to Watson. Before him opened a tremendous vista of manipulating human emotions and behavior and reconstructing human nature, to which possibilities he has devoted many glowing and eloquent pages. On these prophetic flights we cannot follow him, since here we must confine ourselves to the narrow subject of fear, and consider how it was trained into one little tot.

Albert was an extraordinarily good baby, eleven months old, who had never cried, at least not until Dr. Watson began his experiments and wanted him to cry. Albert first showed by repeated tests that nothing could frighten him but loud sounds and being allowed to fall. He had been playing for weeks with a white rat. One day, however, just as he reached for the animal, a steel bar immediately behind his head, three feet long, was struck with a carpenter's hammer. Albert jumped violently and fell but did not cry. These experiments were continued day after day with a combined stimulation of rat and sound. Gradually a fear response was built up, so that when the rat was presented alone, Albert instantly jumped, began to cry and tried to crawl away on all fours as fast as he could.

This much was clear, then. Any object associated with an instinctive fear could in time be the cause of fear. But there was still another point to be settled, namely that of determining to what extent the associated or conditioned fear response could be carried over to similar objects. If Albert had been given a fear of rats would be be afraid of all furry objects? For weeks Albert had been playing happily with rabbits, pigeons, fur muffs, the hair of the attendant, and false faces. Would his fear carry over? Each of these objects was presented in order, and toward all Albert responded by whimpering, crying, crawling away, though when a moment later his blocks were given him, he played contentedly with them, smiling and laughing. Albert thus was left with a fear of all things furry, acquired through a spread or transfer from the original fear.

Most children and young people and many adults remain in the early stage where they are afraid of all objects within a certain class, just because of a superficial resemblance. Our superstitions illustrate this very well.

How shall we proceed to remove those fears acquired through association with instinctive fears? Certain common but inadequate measures of dissipating them are presented first.

Many persons believe that preventing any contact between the object feared and the child will result in the latter's "forgetting" his fear. A typical remark is "Just keep him away from it and he'll outgrow it." This method is not usually effective. The child afraid of a rat is likely to remain that way even though he may not see it for a long time.[2]

Another method in general use is to discuss the fear with the child. For example, a little girl of five is afraid of rabbits. For a number of days, she is shown no rabbits but receives instead a ten minute talk about them. She is given a picture book of Peter Rabbit, a toy rabbit and several rabbits modeled from plasticine. At the end of a week of such conversations and stories, she is shown the rabbit again. Her reaction is the same as it had been at the first encounter. Though she is willing to touch it while it is in the hands of the adult, no sooner is it released on the floor than she sobs, "Put it away, take it."

The method of discussion, therefore, is not promising with very young children, though, as we shall see with the next type of fears, it is often successful with older ones.

Some parents faced with a child who is afraid, say of water, will insist on the child's frequent exposure to his fear, believing that in this way the child will learn to overcome it.

This method seldom works and nearly always does mental and emotional injury to the child, only intensifying the fear, though the child may learn to conceal its outward manifestations in order to avoid parental criticism.

A common way of treating fears is to employ social pressure. The child who is afraid of any object of which his group is unafraid is called a "fraidy cat". A four year old was afraid of frogs. One day when he had been taken to an aquarium, a friend of his picked up a frog and turned to him with it. He screamed and fled. At this, he was chased and derided. But, as might have been expected, this in no way decreased his fear.

Ridicule is probably one of the most unsafe methods generally used for eliminating fears. It not only tends to increase the fear toward the specific object, but makes the child afraid of society as a whole. Since social relationships in his case are so often productive of pain, the child is likely to become shy and withdrawn. The little boy afraid of frogs may show his distress subsequent to the aquarium episode by furious thumb-sucking, tantrums or nightmares which parents are apt to consider ailments in themselves rather than signs of an unhappiness which at other times might have had other causes, but which here springs from fear.

If we are to introduce social factors in the attempt to eliminate fears, the method of imitation may yield better results than that of intimidation.

Bobby, thirty months old, was afraid of rabbits. One day while he was playing with two little girls, a rabbit was brought into his room. There was a momentary show of fear, but when his playmates dashed up to the rabbit and talked excitedly and with pleasure about it, Bobby instantly became interested in it, ran forward and wanted to see what it was all about.

On occasions such as the foregoing, the child should not be urged to watch or given a lecture on the difference between other children and him. It is enough to expose him to the sight of children who face without fear the objects or situations of which he is afraid.

One of the most successful methods used so far in removing fears in very

[2] The instances cited in this section are all taken from Dr. Watson's "Behaviorism".

young children is that of unconditioning. If fear can be trained in, it can be trained out; conditioning may be neutralized by unconditioning. But first we should ascertain, if we can, whether the object feared is the original one (the rat) which had become associated with the instinctive fear response (loud sound) or whether it is one which because of its resemblance (bunny) to the object (the rat) had awakened the fear response.

Peter, a three year old, was afraid of all furry objects, his fear having originated in an adventure with a rat. Peter's fear was handled in the following manner: One day, while he was seated near a small table in his high-chair having lunch in a room about forty feet long, a rabbit was displayed in a wire cage, just far enough away not to disturb his eating. On succeeding days the animal was brought closer and closer until it could be placed on the table, then in Peter's lap. Finally the child would eat with one hand and stroke the rabbit with the other. With the disappearance of his fear reactions to the rabbit, Peter's fear of cotton, fur coats, and feathers was entirely gone.

Another useful method depends on the fact that the child should not merely sit still and learn to tolerate a feared object, but in the case of certain fears should be able to act positively and attack the fear situation by himself. He may be led to do this if such a direct facing of his fear is the only way he can get something he wants very much. The incentive, however, should not be presented as a reward or bribe.

This method was successfully applied in an experiment with a small group of children who were afraid of height. Each one was able to walk across a plank in mid-air when a box of toys and games was placed on the board opposite the starting point. In a similar manner children who were afraid of dark places were led to enter the room when, during the course of a game, a ball was thrown into the room ostensibly by accident, and it was the child's job to go after it.

II

The second class of fears are those which are the aftermath of unpleasant experiences. Because of a tyrannical first-grade teacher, a youngster may develop a fear of school. A child bitten by one dog may fear all others. Many of us have acquired a fear of doctors or dentists through a painful initial contact. A very clear example of this type of fear is shown by a young woman who always became terror-stricken at the sound of running water. Her fear was inexplicable until the following story was unfolded: As a child of six, she had fallen off a river bank and had become wedged in between some rocks of a small waterfall. Her aunt, with whom she had gone walking and who had wandered off, found her hours later. In response to the little girl's plea that the episode be kept from her parents, the aunt promised "I shall never tell." Children are sometimes afraid to have their parents find out about a frightening experience in the belief that the parents will assume it was the child's fault that the incident occurred and that they will be scolded. Circumstances thereafter took the aunt to another part of the country. The girl completely forgot the experience and it was only years later, upon a chance meeting with the aunt and the latter's resurrection of the incident, that the fear was cleared up.

A girl of twenty, otherwise normal and happy, suffered from fainting fits. These occurred only when she opened a package containing flimsy wrapping paper or when a window curtain blew in her face. For years the young woman had feared chance contact with gauze-like materials without any idea of the basis for this fear. Then one day she recalled an incident that had been completely forgotten. When she was seven she had been suddenly awakened from a sound sleep one evening to find hovering over her a friend clothed in a bedsheet to resemble a ghost. And with this recollection came release from her thirteen year-old fear.

Children who have been under the influence of someone with an irritable temper or witnessed attacks of violent anger, may develop a deep fear, even when the anger has been directed at another person. Such a youngster may jump at sudden sounds or loud voices and will regularly search faces for signs of approaching danger. If he believes his suspicions are about to be realized, he may run and hide rather than face the imminent storm.

Youngsters who have had many unpleasant experiences become generally anxious and insecure. Everything novel and unexpected, whether of places or people, is likely to arouse great apprehension. Thus arises frequently the abnormal shyness with strangers which some children show

One way of lessening the effect of fears resulting from painful experiences is to anticipate the difficulty so that the child does not have to meet his fears alone or without moral support. It is true that a child should know it is sometimes inevitable for him to enter a fear-producing situation and that no one else can take his place when this happens. Yet he also should know that he can call upon adults for assistance, conversational and otherwise, when necessary.

Another useful device is to have the child repeatedly encounter the feared object or situation under circumstances that tend to lessen the object's fearfulness. A substitute or imitation of the dreaded object may be the means of doing this. The child afraid of animals ought to be taken on frequent trips to the zoo or given a small pet of his own.

A four-year-old boy was rescued from a burning apartment one evening by his nurse, who was the only person with him at the time. The resulting fear was handled by giving the youngster a toy fire engine which closely resembled the real thing, even to the extent of a hose which threw water a distance of twenty feet. In the course of extinguishing his little make-believe fires, he was able to talk freely about his experience, and the effects of the fright gradually wore off.

A fear rooted in an unpleasant experience may be removed in time if the child's attention is frequently diverted by associating something pleasant with the feared object or situation. A child who is afraid of water may forget his fear while he plays with a new sailboat.

III

The largest group of fears are those which are acquired through direct imitation of those who are afraid. Fears can be caught like colds. Parents and other adults in the home are the chief sources of contagion, with brothers and sisters, playmates, teachers, stories, radio programs and motion pictures, next responsible, the last two usually potent forces only if the child is already a fearful one or if his attention is especially called to certain incidents. Fears also may be picked up through indirect imitation. A child entering a class afraid of a teacher or coming into a courtyard of children fleeing from some bully, is likely to share the fear.

One can take a child destined for a normal emotional life and by using threats as disciplinary devices breed in him an immense variety of fears. "The bogy man will get you in the dark." "The policeman will put you in jail." "The doctor will cut off your ears." It has been found repeatedly that the root of a child's fear has been a threat, made in haste or anger, and then forgotten by the person making it, although not by the child. Temporary obedience and peace in the household may be obtained by such means but only at the price of later emotional difficulties for the object of the threat. In similar manner, teachers are sometimes liable to use sharp and scolding speech, believing that the way to make a child succeed is by scaring him with pictures of the dire failure that awaits him in and out of school unless he mends his ways.

Youngsters are surrounded by many dangers today and frequent injunctions to be cautious are therefore in order. But this should be done through matter-of-fact discussions of the necessity of vigilance. The adult who uses fear as an educational technique, painting lurid pictures of what will happen if the child plays with matches or ignores traffic signals, runs the risk of creating a Frankenstein. Such warnings may or may not prevent mishaps, but even if bodily harm is averted, considerable mental injury may be inflicted. And should the child unluckily meet with an accident, the parent is not likely to help him much in regaining confidence once he is well again. Instead of making him cautiously courageous, in the natural anxiety to forestall a re-occurence, such a parent may only increase his dependence. The youngster often wants to start afresh emotionally, but the parents are the ones who remind him of what has happened.

Children are told or overhear frightening stories involving snakes, mice, worms, etc. In superstitious families, children imbibe a host of superfluous fears and dreads. They are taught that an eye or nose which itches, a black cat, a broken mirror, the thirteenth floor--these, and a thousand other similar facts, all portend evil. Three generations of a particular family exhibited a great fear of toads, the fear being bequeathed from mother to daughter like some precious heirloom.

Many persons find it difficult to keep their emotional distress concerning certain themes from becoming known to their children. Without deliberate intent or awareness, they may therefore systematically teach their children a dread of ill-health, death, doctors, hospitals, or even of life itself.

A mother will unwittingly train her daughter in future attitudes by methodically disillusioning her about love and marriage relationships. A father may often complain about the extreme hardship of earning a living or of the treachery prevalent in the business world. As a result, he instills in his son a fear of leaving home in order to make his own way. When such a father complains about a lazy, shiftless heir, he may not realize that "laziness" and "shiftlessness" are signs of mental ill-health, which has its roots in fear and insecurity.

Though many parents perform herculean labors in keeping their private woes to themselves, it is admittedly very difficult to avoid subjecting children to the indirect effect of fears. Youngsters are wonderfully sensitive to gestures or facial expressions and at an early age become experts in interpreting them.

When we come to methods of handling imitative fears, we find that the most important of these apply to the grown-up himself.

Adults should try to recognize their own fears and avoid discussing them with children in their charge. That they should wish to talk about them is natural. But this should be done with persons their own age and only when youngsters are out of earshot. However, should adult fears reach such a point that young people can no longer be shielded from constant and direct contact with them, the grown-ups involved would be wise to have their own emotional difficulties cleared up.

As for the child himself, one can try to surround the feared object with pleasant associations. A joke directed at it may allay tension, though it is true that this is likely to be effective only in the given emergency. Where the child is able to understand, a better method is to explain to him the origin of the different kinds of fear, especially of the imitative type. The scientific explanation, but simplified to whatever degree necessary, is also in order in the case of fears connected with natural phenomena, like thunder and lightning, which are acquired for the most part and not inborn. The same tactics should be used with fears arising from old-wives tales.

IV

One of the most important class of fears is that concerning one's importance in the social group. Here arises the sense of inadequacy which always has had a local habitation, though it is only recently that it has secured a name: inferiority feeling. The sufferer fears defeat in situations where he must meet social scrutiny and obtain social approval. This type of fear has its roots in the first years of life, though it does not begin to show itself clearly until late in childhood and does not develop in the most mature form until adolescence.

The chief cause of the feeling of inferiority is doubt regarding one's emotional status in the family. A child who thinks himself unloved and rejected by his parents or by his brothers or sisters cannot help but suspect that their low opinion of him is shared by others outside the family. Since so many others seem to think little of him, he begins to accept their evaluation of him as his own.

The insecure child dreads the emotional loss of his parents. In order to prevent this calamity, than which there can be no greater in his entire life, the child tries to bind them fast. He may do this through infantile and immature behavior or through a form of naughtiness which Dr. David Levy has aptly called "dependency aggression". He is always seeking his parents' attention because such attention is to him a symbol of their love.

What is commonly regarded as a superficial fear, that of the dark, is actually of considerable significance. For the fear is never of the dark in itself; since there is no proof that children are born with such a fear. Sometimes, what is frightening is not the dark but what has happened in the dark or what the child, through stories and threats, has been led to believe will happen there. However, darkness may have a still deeper meaning. To the child, it comes between him and those he loves. Because of it, he cannot see if his loved ones are near, nor can they see him, and to the young mind, what cannot be seen, no longer exists. An insecure child naturally is afraid of all separations and especially of the isolation which darkness brings.

A youngster will betray his insecurity in school by dependent behavior, just as he did at home. The child with a feeling of inferiority is shy and timid in a group. He refuses to recite in class, even when he knows the right answer, because he dares not compete with his contemporaries. He may stutter and blush. He withdraws into to himself and becomes a day-dreamer. Occasionally, instead of retreating he attacks and becomes anti-social and over-aggressive, all as a result of his fear. He says to himself: "They don't like me, but I'll make them"; or "They will attack me, but I'll do so first", and we therefore always find him fighting either for recognition or in imagined self-defense.

Since fear concerning the social verdict on the worth of one's personality affects a greater area of the individual's emotional life than do any of the others discussed thus far, the remedy for it is more complex.

If a child is afraid to meet social situations, that is, if he is shy, timid, and feels inferior, he can be helped only to the extent that there can be restored to him a sense of importance in the social group. This is possible only when the child, intellectually and emotionally, is certain he possesses his parents' love and support, in spite of his momentary shortcomings or delinquencies. He ought to feel that he is liked, just for himself as a person. Every child has as his birthright, a claim to expressions of warmth and tenderness. He has even greater claim to being brought up among adults who show they have full confidence in his ability to conquer all of life's problems as they come along. Such a child is not likely to develop any fears regarding his social status. On the other hand, a child who is shy, dependent or "dependently aggressive" because he is fearful, will become only more insecure if these surface symptoms are met with ridicule or punishment.

Anyone faced with a timid and insecure child should be alert to recognize and praise all of his *positive achievements and attempts at self-assertion, however slight.* Criticism should be forthcoming when necessary, but should be forward-looking rather than backward, emphasizing the greater possible success and not the failure. With such a child one should take special care to see that he is placed in a group of equals where he can be given tasks within his powers of achievement. In this way, one insures at least the possibility of successful competition.

V

Thus far, we have considered fears of a specific, particular character, which can be thought of as a kind of mental growths developing by themselves in a small, limited area and as such yielding to simple techniques of removal. There are other fears, which also seem specific and particular, bearing a superficial resemblance to the first kind, but which cannot be removed except with considerable difficulty, since they spread their roots into wide areas of the personality and the emotional life. For this reason, such intense fears are called "morbid" fears, phobias or dreads. Examples of these are found in persons afraid of high places, open and closed spaces, blood, dirt, sin, poisoning, etc.

These fears are neurotic or symbolic fears as distinguished from the previous classes, more or less real fears, and a campaign or re-education by the untrained person is not likely to prove so successful as in the case of the fears described earlier.

In a neurotic fear, the object we think we fear is merely a symbol for an impulse or a situation we really fear. The conscious thought of this true fear, would fill us with too much emotional distress and that is why we have to face it indirectly. This type of fear, therefore, is a pictorial representation of a concealed conflict; a wish and an unwillingness to attempt the gratification of the wish. The fear of falling from windows or precipices or jumping from bridges or high places may mask a desire for self-destruction. The fear of streets may be really the fear of life and of the temptations which beset one outside the home. Moreover, such a dread may be basically a fear of separation from a loved one and is still another way of exerting power over members of one's family, just as in earlier years, a child's fear of the dark may sometimes actually be a fear of losing one's mother and a device for obtaining her love. Fear of school examinations frequently is a neurotic fear, where what the individual fears is not the examination, but this only as it symbolizes a test of his personal validity and an inquiry into his private life.

It is generally believed by psychologists that a phobia results from an intense fear experience to which a sense of guilt has subsequently become attached. Phobias are rarely found in children. But an ordinary fear may develop into one, and that is why no childhood fear should be allowed to persist.

The most serious type of neurotic fear is anxiety. This is characterized by a great sense of inadequacy and a feeling that nothing in life is worth while, as well as by intense irritability. Indecision about trivial matters becomes so great as to paralyze all activity. It is not a particular action itself which is dreaded so much as the consequences, seemingly almost fatal, of making an error.

Anxiety is sometimes associated with specific objects or conditions, such as school performance, one's job, cleanliness, the imminence of disease or illness, going outside after dark, leaving tasks unfinished. In its most typical form, however, anxiety is no more than a vague persistent uneasiness, a sense of impending doom and disaster, that is even more painful and unendurable because one does not know just what it is that he fears. The sufferer seems to be walking day after day along the edge of a cliff blindfolded. All that he knows is that an awful imponderable, a Something will happen either to himself or to his kin.

Anxiety states, like phobias, are neurotic or symbolic fears, where the surface fear is not the true fear and where all the bewildering symptoms represent a code language, the meaning of which is revealed only by specialized psychological techniques. Besides being painful, there is always the possibility that this generalized fear may be communicated to any young person coming in intimate contact with the sufferer.

Suppose we try to sum up some of the general principles involved in the treatment of fears:

Free discussion of all phases of the fear should be encouraged, though it should not be forced. In the case of young persons, one cannot break down the door which leads to the mind of a child; nor will three loud knocks cause it to swing open on its magic hinges. One must wait outside it patiently, until it opens of its own accord. And, of course, this is true of many adults as well. When the sufferer is certain he has a sympathetic audience, he may be willing to talk about his difficulty, provided he himself is aware of the thing really feared. At this time, an attempt should be made to determine the history of the fear, again on the assumption that the fearful one can recall it just by trying to remember.

Some of the simple measures indicated in this article may be tried. Ordinarily they should prove sufficient, if one remembers that repetitions of a particular procedure are nearly always necessary and that emotional re-education is a slow and gradual process. However, where fears are of long standing, their treatment by means of recipes in the family medicine chest is of limited success. This is especially true where the fear is only a surface expression of some deeper unrest and hence relatively unimportant in itself; it is true also in those instances where the individual is unable to recall any of its history. When a fear persists, proving unresponsive to any elementary technique, it may be necessary to invite the assistance of a psychologist or psychiatrist in order to unearth this deeper difficulty or facilitate the recall of the fear's origin.

For a human being to go through life without experiencing fear in some form is hardly possible, and not desirable, could it be achieved. The derivatives of fear is the shape of caution, foresight and a careful weighing of hazards are essential elements in a well-regulated existence. The devices sketched here are ways, not of uprooting and destroying a powerful emotion, but rather of bringing it back under control whenever it has gotten out of bounds. With the progress of psychological science, we shall become ever more resourceful in learning how to place fear under the domination of the intellect and thereby utilize to the fullest what can be one of the most constructive forces for the development and enrichment of the personality.

AN EMPIRICAL CONCEPT OF PHYSICAL GROWTH

HOWARD V. MEREDITH[1]

The "Physical Growth of the Child" is a sector of scientific inquiry which engages the teaching and research abilities of numerous individuals. These individuals are concerned with studying and describing the human child, at successive stages of its life span, in terms of physical or bodily characteristics. Many of them are giving particular attention to the physical growth of the normal or nonpathological child.

As one engaged in instruction and research relating to the physical growth of the normal child, the writer has found himself recurrently confronted with such questions as: What is physical growth? How, if at all, does physical growth differ from physical development? In the event that an important distinction exists between growth and development, are age changes in body proportions manifestations of the former or of the latter?

GROWTH AND/OR DEVELOPMENT

The committee on growth and development of the White House Conference on Child Health and Protection claimed:

> "We use the two terms, growth and development, advisedly as there is a useful and significant distinction between them. By growth we mean increase in size. As opposed to this, development implies an increase in complexity, such as we see in the formation of the four-chambered heart of the infant from the simple pulsating tube of the embryo. It is possible in many instances to have considerable development with very little growth in size. This obviously occurs during the first days following the fertilization of the ovum, before implantation has occurred..."[2]

Lawrence K. Frank, in a 1936 paper under the caption, "What is growth?" stated:

> "...we have already used the two words 'growth' and 'development.' It is important to distinguish clearly between these words...*growth* means simply the process by which one cell *undergoes* self-multiplication, the result being that two new cells are generated or produced....*development* implies much more than growth alone, *for* development really consists of three important processes; first, growth which forms new cells by self-multiplication of preceding cells; second, differentiation of these cells as regards both structure and action (i.e., specialization as bone, muscle, nerve, blood, and other cells); and third, the organization of all the parts which growth and differentiation have produced."[3]

The incompatibility of the two citations is too apparent to need extended

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[1] From Iowa Child Welfare Research Station, State University of Iowa, Iowa City, Iowa.

[2] White House Conference on Child Health and Protection: Growth and Development of the Child, Part IV, Appraisement of the Child. I. Mental Status, II. Physical Status. New York: Century, [c. 1932] Pp. xix, 344. (p. 4)

[3] Frank, Lawrence K.: What Is Growth? Radio Forum on Growth and Development of the Child, 1936-1937, 2-3. (Mimeographed)

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elaboration. It will suffice to note that the cleavage stage of the organism is employed by the White House Conference committee as a crucial instance of development --

> "It is possible in many instances to have considerable development with very little growth in size. This obviously occurs during the first days following the fertilization of the ovum..."[4]

and by Frank as a clear manifestation of growth --

> "...growth begins in the egg...this cell becomes separated into two cells... These two then separate again into four, into eight, into sixteen, and so on, by a constant process of self-multiplication."[5]

A somewhat different approach to the establishment of a distinction between growth and development has been made by Harold C. Stuart. To quote:

> "Just as mankind has slowly developed through the ages, so each individual man must start as a single fertilized cell and must pass through a great variety and number of stages before he reaches maturity. These stages repeat to a certain extent the history of the development of his species. The term *development properly refers to this process of change* from the single cell to the complex mature adult, in contrast to *growth* which refers to simple increase in size. If a child merely grew larger, using the word in this sense, a baby would be a small reproduction of a man. If he merely developed, man and child would be alike in size, though very different indeed in capacity and proportions."[6]

The first question to arise from a reading of this quotation is whether any meaningful or useful purpose is attained by attempting to abstract "simple increase in size" of the human organism from the "process of change from the simple cell to the complex mature adult." Additional questions present themselves when one carefully considers the statements made with reference to development. On the one hand, development appears to be defined as change in complexity. Here it would seem to imply such phenomena as change from a unicellular organism to a multicellular organism; change from a two-germ-layer organism to a three-germ-layer organism; change from an embryonic disk consisting of merely cephalic and trunk regions to a fetus with articulate internal organs such as brain, heart, and liver, and external features such as upper and lower extremities, digits, nose, and ears; change from a newborn infant lacking calcification of the permanent teeth, ossification of the carpal bones, and heavily pigmented axillary and pubic hair to an adolescent with all these items of complexity. On the other hand, development is referred to as resulting in marked changes in proportion. Here it would seem to cover such changes as the lengthening of the trunk in relation to head and neck length, the lengthening of the legs in relation to the arms, the widening of the thorax in relation to its depth, the lengthening of the hands and feet in relation to their breadths. It would appear, then, that Stuart's discussion of development tends to confuse the emergence and submergence-or-loss of parts (changes in complexity) with the varying rates of change within and between parts (changes in proportion).

Helen Thompson, in 1934, defined growth as a three-aspect process of augmentation, differentiation, and integration. She wrote:

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[4] *Loc. cit.*, p. 4.

[5] *Loc. cit.*, p. 3.

[6] Stuart, Harold C.: Healthy Childhood: Guidance for Physical Care. New York: Appleton-Century, 1933. Pp. 393. (p. 53)

> "Growth is commonly conceived of as a process of augmentation and differentiation. ...Another concept such as conjugation or integration is necessary for an adequate interpretation."[7]

This definition is obviously similar to that given by Frank, not for growth, but for development.

> "...development really consists of three important processes; first, growth which forms new cells by self-multiplication of preceding cells; second, differentiation of these cells as regards both structure and action... and third, the organization of all the parts which growth and differentiation have produced."[8]

Frederick S. Hammett recently expressed the view that "proliferation, differentiation, organization, and mass increment" are all manifestations of growth. For him:

> "... growth is not single. It is multiple, the combined expression of developmental and incremental factors. Increase in cell number is as much growth as is increase in cell size. Increase in cellular specialization is as much growth as is increase in cellular segregation."[9]

Hammett and Thompson each use the term growth to the exclusion of the term development. Their definitions of growth are in general agreement, and are similar to Frank's definition of development.

When one turns from the available attempts at definition to a direct examination of research reports, it is no less difficult to discover any manifest difference between growth and development. The type of problem investigated is the same for studies claiming to describe various phases of the physical growth of the child as for studies claiming to treat the physical development of the child. In the same sense that one investigation uses "progression of development" another uses "growth with advancing age," in the same sense that one uses "growth period" another uses "stage of development," in the same sense that one uses "phase of development" another uses "aspect of growth," in the same sense that one uses "growth curve" another uses "developmental trend," in the same sense that one uses "course of development" another uses "course of growth," and in the same sense that one uses "growth sequence" another uses "developmental pattern."

Many investigators use the terms growth and development interchangeably. Thus, for instance, Baldwin, Busby, and Garside wrote:

> "The function of students of growth and development is clear, that is, to trace and analyze specific traits of growth, constantly seeking broader and more fundamental principles of development."
>
> "The data for the study were collected...with a view to discovering some basic principles of anatomic growth from the development observed in the bones."[10]

The complete interchange of terms is unequivocal. These authors considered they were, at once, studying "traits of growth" to discover "principles of de-

[7] Thompson, Helen: A Third Aspect of Growth. Human Biol., 1934, 6, 405-407. (p. 405-406)

[8] Loc. cit., p. 2-3.

[9] Hammett, Frederick S.: Introduction to Growth. Growth: A Journal for Studies of Development and Increase, 1937, 1, 1-2. (p. 1)

[10] Baldwin, Bird T., Busby, Laura M., and Garside, Helen V.: Anatomic Growth of Children: A Study of Some Bones of the Hand, Wrist, and Lower Forearm by Means of Roentgenograms. Univ. Iowa Stud., Stud. in Child Welfare, 1928, 4, No. 1, Pp. 88. (p. 6)

velopment" and studying observed development to discover principles of growth.

It appears, then, that no "useful and significant distinction" has yet been drawn between the physical growth of the child and the physical development of the child. Those whose task it is to synthesize the research literature do not find it "useful" or practicable to subdivide their materials into "Studies on Physical Growth" and "Studies on Physical Development." Likewise, those whose task it is to make original investigations neither distinguish between problems of growth and problems of development nor consider it "significant" to attempt the formulation of diverse procedures for attacking problems of growth and problems of development.

AN EMPIRICAL CONCEPT OF PHYSICAL GROWTH

What is physical growth (or physical development)? From the empirical standpoint, physical growth is that body of findings which is studied and cumulatively extended by investigators of physical growth. In other words, it is the total series of bodily or structural changes found to characterize the ontogenetic life history of the individual. The series of physical changes thus far described for the human child may be subdivided, in the writer's opinion, into changes in size, changes in complexity, changes in proportion, and changes in pigmentation and texture.

CHANGES IN SIZE

Individuals concerned with describing the physical growth of the child have given considerable attention to change of the organism in size. They have studied changes with age in stature, sitting height, head length and breadth, width of shoulders, width and depth of thorax, girth of arm and leg, surface area of trunk, transverse diameter of heart, weight of thymus gland, and an extensive list of other characteristics. In so far as they have been scientists they have not set out to study increase or augmentation in size, but rather to study change in size regardless of the direction of the change. Moreover, they have not always found increase in size. Mean curves for antero-posterior diameter of the thorax register a slight decrease in the absolute magnitude of this dimension between two and three years of age, mean curves for weight of the thymus gland show a fairly marked descent during the second decade, mean curves for thickness of skin and subcutaneous tissue at front and back of the thorax exhibit a general decline for the postnatal age period from six months to six years, and mean curves for thickness of skin and subcutaneous tissue at front and back of arm show an increase for females but a decrease for males from around eleven years to the close of the second decade.

That the study of change in size during successive intervals of the life span constitutes a major aspect of physical growth appears evident from the amount of research which falls in this category and from the comprehensiveness of the approach that has been made to size change. Apparently it is hardly more axiomatic to say that the goal in the case of each physical measurement proposed for scientific inquiry is to discover the facts about this measurement than to say that one large sector of these facts has to do with change in size. This follows since in discovering the facts for change in size at least four master questions are frequently entertained. First, what -- under present conditions of life -- is the typical course, magnitude, rate, and duration of the sequence of change for this measurement? That is, does the measurement increase during certain intervals, decrease during others, and during still others remain constant? What is the average amount of the gain or loss from age

nd what is the variability in gain or loss at each age? At what ages
ma and minima occur in the rate curves for the measurement? Over
rtion of the life span does the sequence extend? Secondly, what are
ors that may significantly modify the sequence? Is it accelerated or
d in relation to sex, diet, exercise, sunshine, and fresh air? Is it re-
r inhibited in relation to order of birth, housing and sanitation, disease?
how is the sequence of change for this measurement inter-related with
s of change for other characteristics of the organism? Does it synchronize
uences for other physical measurements or with sequences for certain
r motor functions? Does it systematically diverge from certain sequences?
, what constellation of factors produces the most desirable sequence of
or this measurement? How might the sequence be controlled in the
of efficiency, poise, and longevity for the individual? How might the
be controlled in the interest of racial survival and betterment?

CHANGES IN COMPLEXITY

econd major aspect of physical growth is that of change in complexity.
nan organism undergoes marked changes in its physical complexity, as
its size, between fertilization and senility. It changes, for instance,
embryonic disk of three germinal layers to an organism with articulate
unk, and heart; to an embryo with branchial arches, mouth cavity,
ds, liver, and external tail; to a fetus with eyes and eyelids, nose and
sed upper and lower lips, digits and nails; to a preschool child with
ed fontanelles, well-developed cervical and lumbar curves, a full com-
of deciduous teeth, and osseous centers for almost all the epiphyses of
eton; to an adult with heavy axillary and pubic hair, deciduous teeth
by permanent teeth, epiphyses united to their respective diaphyses,
rd or breasts.
in the case of size, it is essential to regard this aspect of physical
as concerned with change in complexity and not merely with increase
lexity. Two examples will make this apparent. First, the osseous
is more complex during the first two decades of postnatal life than
uring prenatal life or in adulthood. At birth the osseous skeleton con-
nost entirely of primary centers of ossification. At various times be-
irth and puberty about four hundred epiphyses or secondary centers
eir appearance. Following puberty "the most striking feature in the
of the skeleton, is the knitting of the epiphyses with their shafts."[11]
een estimated that the child's skeleton consists of roughly two hundred
y bony masses in early infancy, three hundred and fifty bony masses
puberty, and two hundred bony masses in adulthood. From the stand-
number of skeletal units, the sequence is thus one of initial increase
lexity and later simplification or decrease in complexity.
ondly, the dentition of the kindergarten child is markedly more complex
at in the newborn infant or the adult. The typical neonate shows no
of the deciduous teeth and no calcification of the permanent teeth.
five years of age the child has twenty deciduous teeth fully erupted
enty-eight permanent teeth almost completely calcified -- making a
forty-eight in all. By fourteen years of age the deciduous teeth have
carded and the dentition simplified to twenty-eight permanent teeth
and four permanent third molars almost ready to erupt.
ose who have defined development (or growth) as increase in complexity
to have avoided their obligation to designate also the phenomenon repre-

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from an address by Professor Richard E. Scammon.

sented by such items of decrease in complexity as submergence and loss in intrauterine life of the external tail and lanugo, absorption and loss in childhood of the deciduous teeth and in old age of the permanent teeth and alveolar arches, and the reduction between childhood and senility (due to epiphyseal union and suture closure) in the number of bony masses which comprise the skeleton.

CHANGES IN PROPORTION

It has long been common knowledge that the newborn infant differs widely from the adult in the configuration of his body. Probably the features of this difference in the infant's form or shape which have been most evident to the lay observer are his relatively large head, short legs, stubby hands, short face, and broad, low-bridged nose.

Moreover, rigorous study of the gradual modifications which occur with age in the proportions of the body is by no means unrecognized as a major aspect of scientific inquiry on physical growth. This is amply supported by the research literature on the physical growth of the child. Age-to-age changes in the ratio of one physical dimension to another have been studied by means of the cephalic index, the thoracic index, the intermembral index, the brachial index, the crural index, the stem-stature index, the hip-shoulder index, the facial index, the nasal index, the dental-arch index, and a long series of other indices.

Changes in proportion, like changes in size and complexity, do not take place solely in one direction. The thoracic index has been found to increase during the embryonic period, remain constant during the fetal period, decrease with the establishment of respiration, and increase during infancy. Findings for the ratio of hip width to shoulder width give a rising trend during fetal life and the first three postnatal months, a declining trend from three months to about one year of age, and a rising trend from one year to about four years of age. The mean curve for hip width in percentage of leg length has been found to rise to the third postnatal month and fall during the period from three months to six years of age. Findings for the index of leg length in percentage of stem length show an increase to around fourteen years of age and a slight decline between this age and the attainment of adult stature. Further citations are superfluous since the purpose here is only to illustrate the fact that certain changes in proportion fluctuate in direction from age to age. Investigators set themselves the task of determining the sequence or trend for a given proportion without regard to the course the trend may be found to take.

CHANGES IN TEXTURE AND PIGMENTATION

The fourth aspect of physical growth has been explored far less than the three aspects already discussed. It concerns changes during the individual life cycle in texture and pigmentation of the body tissues. Problems falling within this heading include changes with age in texture of bone, quality of muscle and subcutaneous tissue, texture of hair (e.g., change of pubic hair from fine to coarse at puberty), color of eyes, color of hair (including graying), and color and texture of skin. Numerous studies of eye color and hair color have indicated the general tendency to a darkening (increased pigmentation) of these characteristics during childhood.

SUMMARY AND CONCLUSION

The position that there is a useful and significant distinction between physical growth and physical development is found to be unsupported either by theoretical definitions of growth and development or by the research literature on the physical growth of the child. It is concluded that "physical growth" and "physical development" may be used (at least for the present) as interchangeable terms.

An empirical concept of physical growth (or physical development) is developed. According to this concept physical growth is the study of bodily changes which occur in a biological organism with advancing age. Applied to the human organism, it is the study of changes taking place in the size, the complexity, the proportions, and the texture and pigmentation of the body between the beginning of embryonic life and the close of senility.

The intended purpose of the paper will not be fully realized unless other workers see fit to evaluate the concept and to elaborate it or cite its weaknesses.

THE EFFECT OF NURSERY SCHOOL TRAINING: INSECURITY FEELINGS

RUTH ANDRUS AND EUGENE L. HOROWITZ[1]

Fundamentally involved in many theories of personality is the sense of security of an individual. Certainly nursery school practice is designed to develop within the child feelings of security which will serve as the firm base from which the growing personality may develop and expand in most desirable fashion. In spite of the many differences both in theory and practice, few educators of very young children would dissent from the statement that one of the goals of education is to increase the general security of the children (whatever differences may appear in their means to the end). We can not here undertake an elaboration or definition of security in more basic terms, for the present let us accept the concept without further analysis.

I

A rating scale (see page 170) was prepared by Miss Marion A. House and was designed to secure teachers' ratings on children in nursery school which would provide an index of the security - insecurity feelings of the individual children. Since the data collected for this study were available to the present writers, an analysis was undertaken of the relationship between nursery school experience and the children's ratings on this scale.

A priori analysis of the items of the questionnaire discloses that each item may be conceived as representing a "symptom" of insecurity (as customarily discussed from the psychiatric-educational point of view). The greater the frequency of the display of any of these symptoms, presumably the greater the insecurity of the child. Based on these considerations, a Likert-type scoring scheme was devised using numerical scores of 1, 2, 3, 4 and 5 for the corresponding columns, increasing score representing more frequent manifestation of symptoms, or, the higher the score, the presumably greater insecurity of the child. Where the X column was used, a score was assigned: the average of all the items not rated by a check in the X column, in order to permit direct comparison of scores assigned individual children.

These rating scales were distributed throughout the schools of the Nursery School and Parent Education Program of the Federal Works Progress Administration of New York State during March 1937. These scales were distributed with directions for their use (see INSTRUCTIONS TO RATERS) and ratings were applied by three people in each school for each child. The three raters were generally the head teacher, the assistant teacher, and the nurse. These schools are under the general supervision of one office with local schools under the more intimate supervision of a regional supervisor. In order to minimize the differences introduced by studying schools the educational policies of which are dictated by different individuals, seven schools under one regional supervisor were selected for the analysis here presented. Restriction of the time for the actual ratings to a period of two weeks reduced to a minimum difference in ratings due to the lapse of time.

These data are subject to all the limitations of the rating scale approach, nevertheless they are of some value although this may not be the face value. The first consideration in the analysis is reliability. Both the scale and the

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[1] From Child Development and Parent Education Bureau, The State Education Department, The University of the State of New York, Albany. The writers wish to express their appreciation for the help given by Miss Marion House, WPA regional supervisor and the WPA nursery school teachers in collecting data as well as the assistance of C. E. Fisher and James Alger, WPA statisticians.

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Form RES651

The University of the State of New York
The State Education Department
Child Development and Parent Education Bureaus
Albany

To be filled out by three or more raters, independently

To be filled out for each child by each rater

To be returned to E. L. Horowitz, Child Development and Parent Education Bureau, State Education Department, Albany, N.Y., by: ____________________

INSTRUCTIONS TO RATERS

1. Consult no one before making the ratings; make them as independent and objective as you possibly can.
2. Read the whole scale before rating any items.
3. In rating each item, disregard your ratings for that child on every other item; try not to let general impressions color your judgments about specific aspects of the child's behavior.
4. Rate the entire group of children on one item before rating on another item.
5. Use the back of sheets for specific comments, illustrations or noteworthy episodes that throw light on the ratings.
6. Be sure to fill in a rating for each item called for.

FORM Res 654

The University of the State of New York
The State Education Department
Child Development and Parent Education Bureau
Albany

Child's name ____________________

School ____________________

Rated by ____________________

Date ____________________

For each item, indicate rating by placing a check in the appropriate column.

Child has not been exposed to a situation that would stimulate this X	Child has *never* done this, to my knowledge 1	Child occasionally does this 2	Does and does not do this equally often 3	Does this more frequently than not 4	This is a characteristic response which almost always occurs 5	
						Frequent anger outbursts or temper tantrums
						Nervous habits (biting nails, sucking thumb, handling genitals, etc.)
						Prefers company of children younger than himself or company of adults
						Assumes role of "bully" with other children
						Depends upon whining, crying and tattling to get attention
						Displays unusual interest in own health, ailments and safety
						Remains physically inactive and offers no resistance to imposed authority
						Oversensitive to suggestion or criticism
						Prevented from facing reality by withdrawal into world of fantasy
						Seeks satisfaction by conduct that brings him into unpleasant relationship with other children and adults

raters are open to question and direct intercorrelation of the total scores assigned by the three raters in each school seems a satisfactory way of estimating the reliability of the data without attempting analysis of the causes of unreliability. These intercorrelations are presented in Table 1.

TABLE 1

RELIABILITY
Intercorrelations of total scores on rating scales assigned by the different raters

School	n	Coefficients
A	20	.73 .71 .94
B	25	.57 .74 .64
C	19	.23 .74 .45
D	25	.70*
E	26	.30 .43 .34
F	24	.36 .60 .60
G	23	.29 .47 .58

*There were only two raters in school D, consequently there is only one coefficient of intercorrelation possible.

These reliability coefficients are far from high, the median is .58, but if the scores of the three raters are combined by summation to give a single score, this score may be assumed to derive from a scale with a reliability of .81 (applying the Spearman-Brown- Prophecy Formula for estimation of reliability of a scale three times as long as one yielding a coefficient of .58). While one might well hesitate to apply this score as an objective description of a particular child, we may proceed with further analyses.

II

In this report our primary interest is the effect of nursery school training and this analysis is undertaken by a correlational procedure. Within each school, to minimize extraneous factors, the combined score assigned by the three raters (two in school D) is correlated against the number of months elapsing between the original registration of each child in the schools (which remain open twelve months the year) and the time at which the rating scale was filled out. Where used, chronological age is, of course, computed from date of birth. Table 2 presents the correlations between score on the scale (high score interpreted as greater insecurity) and length of time in the nursery school (col. 2),

TABLE 2

EFFECT OF TRAINING
Relation of score to age and experience in school
1. Score on rating scale. 2. Time in Nursery School.
3. Chronological age.

(col.1) School	(col.2) r 12	(col.3) r 13	(col.4) r 12.3	(col.5) range of time in N.S. (mo.)	(col.6) range of ages (mo.)
A	.07	-.10	.14	3 - 12	31 - 62
B	.16	.10	.24	4 - 6	30 - 54
C	.37	-.09	.44	2 - 12	35 - 58
D	.61	.07	.61	3 - 33	33 - 59
E	-.08	-.35	-.01	6 - 9	30 - 56
F	.32	.40	.01	3 - 30	31 - 60
G	.15	.11	.15	4 - 10	30 - 60

and chronological age (col. 3), and the partial correlation with time in the school partialing out age (col. 4). Both the age range of the children (col. 6) and the range of training time (col. 5) are also presented.

Column 4 of Table 2 proves an effective summary. In six of the seven schools the correlation between "insecurity" as measured by this rating scale, and length of time in the nursery school, partialing chronological age out, is positive. In the seventh school the negative coefficient is only .01. The coefficients are low, the median is +.15. The nature of these results, the positive correlation between insecurity score and time in the nursery school, requires either a more careful analysis of nursery school practice or a more careful analysis of the concept of insecurity represented by the rating scale used. The latter seems a reasonable first step.

In line with the focus of the interest in this paper, the analysis of the scale was undertaken by correlating the scores of the children on each item against length of time the child had been in nursery school, still separately for each school. The method of scoring each item is described above, and for this analysis the scores on each item assigned by the three raters were summated so that there was a theoretically possible range of 3-15 for each item. These correlations are presented in Table 3.

TABLE 3

ANALYSIS OF SCALE
Correlation between individual items of the scale
and length of time in the nursery school for each school separately

	ITEM									
	1	2	3	4	5	6	7	8	9	10
A	.04	.11	.39	.07	-.06	.00	-.37	-.02	-.34	.29
B	.06	-.09	.11	.02	.28	.36	-.08	.07	.22	.07
C	.41	-.26	.15	.09	.24	.52	-.18	.41	.02	.09
D	.44	.43	.27	.58	.02	.04	-.39	.34	.40	.46
E	-.10	-.06	.32	-.20	.04	-.05	-.23	-.20	-.02	.12
F	.13	.42	.15	.64	.44	.60	-.24	-.05	-.12	.18
G	.10	.13	-.11	.02	.02	.20	-.48	-.01	.23	.19

Inspection of Table 3 yields two points of interest-- there is considerable variation among the schools and considerable variation among the items. At present the latter variation is of major interest, though if nursery school practice were to be investigated, the former might prove invaluable as a point of departure. If the coefficients are classified as positive, negative or zero, we find two items indicating unanimity of effect in the schools, items number 7 and 10. The effect on these two items is in the opposite direction, the correlation coefficients being all negative on item 7 and all positive on number 10. That two items included within one scale should show such differences suggests that the composite may not represent a true unity, something besides insecurity may be involved.

A summary of Table 3 reveals the fact that the correlation is positive in 7 schools for item 10; in 6 schools for items 1, 3, 4 and 5; in 5 schools for item 6; in 4 schools for items 2 and 9; and in 3 schools for item 8. From this recapitulation it seems that scores on items 1, 3, 4, 5, 6 and 10 tend to be correlated positively with nursery school training whereas scores on 7 and perhaps 8 tend to be correlated negatively. Perhaps the difference between these groups of items may serve as a clue to the elements in the scale. Item 8 reads, "Oversensitive to suggestion or criticism;" item 7 reads, "Remains physically inactive and offers no resistance to imposed authority." The correlations suggest there is a tendency for children as a result of nursery school experience to become less oversensitive to suggestion or criticism, and a marked tendency to become less inactive and to offer resistance to imposed authority. (The "double-barreled" nature of item 7 makes interpretation difficult. Were ratings made on the basis of physical activity or resistance to authority?)

It is the opinion of the present writers that the results of the analysis of *item 7 of the rating scale furnish a clue to the fundamental questions involved* in the questionnaire. Recent studies of the patterning of behavior in children of this age suggest that application of adult social and ethical classifications is an unsatisfactory way of analyzing the behavior. The behavior must be seen in the light of the child's organization of personality in order to be understood. A complete analysis of that organization is not yet available, but one fundamental axis about which the personality seems to be structured is that of the general activity involved. Whether a particular response requires a great or small degree of gross overt activity or social outgoingness is a more important consideration in predicting behavior at this level than whether it is socially desirable or undesirable. The obtained negative correlations between the school experiences and scores on items 7 and 8 of the scale provide confirmation of the correlary that the schools tend to decrease "inactive" behavior. The positive correlation between score on item 9 and the school training in four of the schools (negative in three) merits further consideration and analysis, which, unfortunately, due to lack of supplementary data can not be presented here. It may be that the complex wording of the question resulted in misinterpretation, but this suggestion can not be considered as either final or satisfactory. Perhaps item 3 warrants further consideration. The company of younger children may be construed as providing outlet for more activity than the company of children of an equal age or the company of adults. A more likely interpretation is that the correlation is an artifact. The longer children are in the nursery school, the older they become, and in consequence, the children who are in school longer will be forced by the relative age of their colleagues to be tending to play with children younger than themselves. (The correlations between chronological age and length of time in the nursery schools for the seven schools studied range from .04 to .79, all positive.) This tendency may then be construed by the raters as a "preference."

Items 4, 5 and 10 are probably functionally interrelated but as suggested by the preceding reference to the axis of activity-inactivity as are interpretation, *the consideration of these manifestations (as well as item 1) without* simultaneous study of other forms of activity on which an ethical approval might be placed is psychologically unsound. Elaborate discussion of the specifics here studied without the more adequate framework might easily lead to an incorrect emphasis in the evaluation of the schools.

That item 6, "Displays unusual interest in own health, ailments and safety" correlates positively with nursery school training in five of the seven schools is of especial interest. From the orientation of the scale, "unusual interest" may be construed as symptomatic of insecurity. To school administrators and teachers familiar with the usual interest displayed by young children in personal hygiene and health, an increase in interest is welcomed as an encouraging sign. The data here developed suggest that the schools are functioning to improve health habits and interests on the part of the children as well as to maintain and improve health standards. Merely to undertake the latter without the former would scarcely represent the functioning of an educational program. That health interests of the children are being stimulated by the nursery schools is a matter of signal importance in the understanding of the functioning of these institutions.

III

The discussion above has pointed out the difficulty of interpreting the total scores on the rating scale used. The reliability of the ratings by the teachers, as presented above, indicates that there is sufficient cohesion to the elements to make consideration of total score not impossible, though the further discussion indicates that interpretation of the total score is difficult. Let us, for a little while, consider the total score as an index of some unnamed aspect of the personality of the children. In enunciating a program of education which considers the wholesome development of personality as a primary objective, an attitude of disbelief is frequently encountered. "You can't change personality" is an implicit criticism in much of the opposition the public nursery school movement is meeting. The differences between curricula emphasizing "content" and "adjustment of the individual" are vast. That schools can develop "content" is demonstrated by the many standarized achievement tests available with grade norms. That schools can influence adjustment is not so readily susceptible of demonstration.

The rating scale used in this study is primarily concerned with adjustment and socialization of the individual rather than matters of specific training. Setting aside the question of the interpretation of the scores, the totals can be analyzed so as to give evidence in regard to the effectiveness of a program.

Since it is also possible to compute the correlation between score and chronological age, holding the effect of training constant, this has been done with the following results: For school A, the correlation is -.16; for school B, it is -.21; for school C, it is -.26; for D, -.13; for E, -.34; for F, +.25; and finally for school G, it is +.11. These findings clearly indicate that when we separate statistically the training and the age factor we find them working in opposite directions.

Training, in 6 of the 7 schools, correlates positively with score; chronological age, in 5 of the 7 schools, correlates negatively with score. Definite statement as to the relative importance of these two factors in the determination of development will vary, of course, as a function of the specific aspect of personality studied and the particular training program. These correlations are presented as evidence that systematic educational programs can be developed to affect personality and individual adjustment.

IV

In the light of the analyses and discussions presented above a number of conclusions emerge. The question of the nature and extent of the effect of nursery school training on the insecurity feelings of children can not be answered, even in part, by the present study.

Evidence has been developed which indicates that educational programs can be developed to influence personality and social adjustment as distinct from mere physical growth.

The analyses corroborate findings concerning the effect of the nursery schools on the activity of the children. Material was also available which indicated that nursery school training stimulates interest in personal health. Results of analyses of effects on several other items of the scale used await future research for adequate interpretation.

Considerable doubt is raised concerning the validity of the underlying theory of security-insecurity as developed in the rating scale used. To the extent that this application of theory is congruent with the general orientation of people interested in child development, further intensive study of insecurity at the early childhood level is needed.

THE DEVELOPMENT OF DIABETIC CHILDREN, WITH SPECIAL REFERENCE TO MENTAL AND PERSONALITY COMPARISONS[1]

GEORGE DAVENPORT BROWN, M.D.[2]

Murchison (17) in the preface to his Handbook of Child Psychology, expresses the opinion that insufficient work has been done on the problems of "nutrition and disease as factors in the development of child behavior" to warrant the inclusion in his book of a chapter discussing these factors. Diabetes mellitus is a good example of a physical disease which may be expected to have mental and personality manifestations.

White (21) remarks that "precocity of mental development (of the diabetic child) has persisted in spite of the delay in physical development." Joslin states that "one-third of our diabetic children were of superior intelligence," this statement being based on the results of giving the Stanford-Binet test to 169 children. Among Joslin's 6,300 patients, treated during more than thirty-five years, there have been 1,126 children (9). He states that data on many of them were incomplete or unavailable, and expresses the hope that his "admittedly incomplete discussion will stimulate research which will help to clarify those parts which are based on presumptive evidence."

The present study was undertaken to gather as complete data as possible on a representative group of diabetic children and to discover in what ways, if any, the diabetic child differs from the normal child in physique, intelligence and personality.

A brief description of diabetes may be in order at this point. Diabetes mellitus is a disorder of the normal functioning of the pancreas. Insulin, the internal secretion of that gland, is produced and absorbed into the blood in insufficient amount, so that the sugar and starches eaten are not efficiently utilized by the body. Indirectly, the metabolism of all foods is deranged in time, abnormal chemical products are formed, and sugar is wasted by being excreted in the urine. Insulin can now be obtained from the pancreas of animals, and when it is injected under the skin of diabetics in amounts and at times best suited to the individual it allows him to eat an essentially normal, well-balanced diet. When diabetics are once regulated as to food and insulin they should have no symptoms of the disease and should be able to live a normal life, except that their diet, exercise, sleep, and as much as possible their emotions should be uniform from day to day as to amount and length or intensity. Neither insulin nor any other substance yet known will cure diabetes; once insulin is necessary or advisable in any case, its use almost always has to be continued throughout life.

SUBJECTS AND CONTROLS

The plan for the present study was to make a comparison of the physical development, mental ability, and personality traits of the diabetic child before and after the onset of diabetes, and also to compare the diabetic child in these respects with a healthy sibling. Our original diabetic group consisted of sixty children, in all of whom the onset of diabetes occurred before fifteen years of age. All our subjects regularly attended the Diabetic Clinic of the Pediatric Department of the University of Minnesota Hospital or the Minneapolis General Hospital.[3] Included in this group were all the diabetic children who attended

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[1] An article in press for the American Journal of Diseases of Children deals with the physical development of diabetic children.

[2] From the Institute of Child Welfare, University of Minnesota.

[3] The University Hospital takes cases almost solely from outside Minneapolis and St. Paul, while the General Hospital admits patients only from Minneapolis.

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the University clinic between December 15, 1936 and April 29, 1937, totaling forty-two cases.

According to Joslin, about one out of every seven thousand children under fifteen years of age in the United States has diabetes mellitus. On that basis, the cases included in this study make up about two-thirds of the diabetic children in Minnesota. Table 1 shows the distribution of our cases in comparison with the total Minnesota population.

TABLE 1

NUMBER AND PERCENTAGE OF DIABETICS IN THIS STUDY COMPARED WITH NUMBER AND PERCENTAGE OF MINNESOTA POPULATION, IN EACH SOCIO-ECONOMIC GROUP

Socio-Economic Group*	Original Group of Diabetics		Revised Group of Diabetics	Minnesota Population
	Number	Per cent	(Per cent)	(Per cent)
I	1	1.7) 10.0	3.51) 10.53	2.38) 9.64
II	5	8.3)	7.02)	7.26)
III	9	15.0	15.79	12.77
IV	12	20.0	17.54	22.61
V.	14	23.3	24.56	21.37
VI	9	15.0) 31.7	15.79) 31.58	9.05) 33.61
VII	10	16.7)	15.79)	24.56)
All	60		57	

*According to Baker's (3) application of the Goodenough-Anderson Occupational Classification (6).

It may seem surprising that a group consisting solely of clinic patients should contain so representative a sampling. There are, however, a number of children from the upper three socio-economic groups admitted to the clinics, because of death of the father or for some similar reason. Both the University and the General Hospitals admit diabetic patients much more freely than patients suffering from diseases of shorter duration, because hospital authorities recognize the life-long nature of diabetes and the expense involved for insulin and special diet. Over one-half of our patients at the University Hospital paid for professional services and for their insulin at cost, while about one-third of the General Hospital cases paid varying small amounts.

Our group was probably somewhat more representative of the population of the area from which it was drawn than was that of Joslin, who does not definitely specify the socio-economic status of his child patients. Since, however, one-half of his patients are reported to have come from outside Greater Boston, where the George F. Baker clinic is located, and one-third from outside densely-populated Massachusetts, it seems altogether likely that few of them belong to the lowest socio-economic groups, for few families in these groups could very well afford the time and money necessary to take a child to the clinic from other states. It is reported (13) that 21.8 per cent of Joslin's entire group of patients are engaged in professional and semi-professional pursuits.

The urban-rural distribution of our patients approximated that reported by Adams (2) for the Mayo Clinic diabetic patients, but although our group contained a higher rural population than most other groups of diabetic patients that have been studied, it is still not sufficiently representative of the rural areas of the state, unless, as Joslin (10) suggests, diabetes is more prevalent in the city population.

In nationality, our group was typical of the Minnesota population. Of the forty-five cases for whom definite information was obtained, ten were "old American" of at least three generations; the parents of nineteen were Scandinavians; of ten, Germanic or semi-Germanic; of five, part or pure-blooded Anglo-

Saxons; and of eight, Slavic or semi-Slavic. Only four patients were Jewish or part Jewish.

By using a healthy sibling as control, rather than a child from the general population, we believed that a more exact comparison could be made as to the number and extent of the other variables. At the same time we realized that the sibling of a diabetic child is much more likely to contract the disease than is the average child. (According to Joslin (9) his chances of becoming a diabetic are thirteen times as great as those of the average child). We attempted, therefore, to diminish this possible error by choosing, whenever available, the next older rather than the next younger child to the patient as control in each family and to prove him non-diabetic. It was possible to obtain only twenty-eight such controls for individual study, but forty-eight for subjective comparison. The median chronological age of the sibling controls was fourteen years six months, the mean age thirteen years ten months. As to socio-economic status they were distributed as follows: Group I, none; Group II, 4; III, 6; IV, 3; V, 0; VI, 5; and VII, 3.

The median age for the entire group at the time of testing was thirteen years one month, the range being from twenty-two months to twenty years one month. Table 2 shows the age distribution of our original group of sixty cases.

TABLE 2

AGE AND SEX DISTRIBUTION OF DIABETIC CHILDREN IN OUR ORIGINAL GROUP

Age	Male	Female	Total
1 yr. 6 mos. to 2 yrs. 5 mos.		1	1
2 yrs. 6 mos. to 3 yrs. 5 mos.			
3 yrs. 6 mos. to 4 yrs. 5 mos.	1		1
4 yrs. 6 mos. to 5 yrs. 5 mos.........		1	1
5 yrs. 6 mos. to 6 yrs. 5 mos.	2	1	3
6 yrs. 6 mos. to 7 yrs. 5 mos.	2	1	3
7 yrs. 6 mos. to 8 yrs. 5 mos.			
8 yrs. 6 mos. to 9 yrs. 5 mos.	1	1	2
9 yrs. 6 mos. to 10 yrs. 5 mos.	2	2	4
10 yrs. 6 mos. to 11 yrs. 5 mos.		4	4
11 yrs. 6 mos. to 12 yrs. 5 mos.	2	6	8
12 yrs. 6 mos. to 13 yrs. 5 mos.	3	2	5
13 yrs. 6 mos. to 14 yrs. 5 mos.	2	2	4
14 yrs. 6 mos. to 15 yrs. 5 mos.	3	6	9
15 yrs. 6 mos. to 16 yrs. 5 mos.	3	5	8
16 yrs. 6 mos. to 17 yrs. 5 mos.	2	2	4
17 yrs. 6 mos. to 18 yrs. 5 mos.			
18 yrs. 6 mos. to 19 yrs. 5 mos.		2	2
19 yrs. 6 mos. to 20 yrs. 5 mos.			
20 yrs. 6 mos. to 21 yrs. 5 mos.		1	1
Total	23	37	60

The median age for the onset of diabetes was eight years six months, and the mean duration of the disease previous to the time of this study was four years nine months.

Our group, as Table 2 indicates, consisted of thirty-seven girls and twenty-three boys, which is somewhat surprising, since Joslin reports virtually no sex differences in the incidence of diabetes among his child patients, though he tabulates small but definite differences in favor of the boys in all age groups. No definite recent sex trends have been reported for diabetic children. Although our group is too small for us to draw any definite conclusions in this respect, the decided preponderance of girls suggests that the increasing number of older female diabetics reported by Joslin (9), John (8), and Adams (2), is probably traceable in part to the onset of the disease in a large number of them during childhood, and is more likely to be associated with hereditary than with environmental factors.

The number of children per family in our group--median 3.8-- compared well with the average number of children per family in Minnesota, median 3.5, with the exception that there is among our cases a large percentage of families with six children and only three families with but one child. Three of our cases had a diabetic sibling, and in one family all three children were diabetics, which is a very rare occurrence. The youngest child in this family was the first to develop the disease, and three years later the eldest experienced the onset of diabetes on the day following the removal of tonsils. In our small group of children the percentage of incidence of diabetes among siblings is greater than among Joslin's subjects (9). We had one pair of dissimilar twins, only one of whom had diabetes. (This is in agreement with Joslin's findings (9). He reports that whereas in only two of sixteen pairs of dissimilar twins did both children have the disease, it was present in both children in nine of thirteen sets of similar twins).

PROCEDURE

The date and type of onset of diabetes, family history, developmental history and clinical and laboratory findings, including height and weight measurements, were obtained for each child from the hospital record and the parents. In addition each patient and control was given a physical examination, weighed and measured. All the patients were proved to have diabetes mellitus in various degrees of severity, and the controls to be free of diabetes and other definite disease. Parents were questioned verbally at the clinic and also by means of a questionnaire. In this questionnaire they were asked to compare the diabetic child in considerable detail with his sibling control. Both the children and their parents cooperated readily in all phases of the investigation. It must be borne in mind, however, that the parents' reports may not in all cases be completely reliable. Information on the diabetics and siblings was also obtained from the schools they attended. All the diabetic children with a mental age of over nine years were given the Intermediate or Advanced Otis Group Intelligence Tests and the Woodworth-Cady Psycho-Neurotic Inventory. All diabetics and siblings included in this study were given the revised Stanford-Binet individual scale for measuring intelligence. (Miss Barbara A. Mayer, psychometrist at the Institute of Child Welfare, gave most of the Stanford-Binet Intelligence tests and supervised the remainder). While the diabetic children were being given the mental tests, observations were recorded by the trained psychometrists so that it might be determined whether they exhibited any behavior that was definitely different from that of normal children in a similar situation.

FINDINGS

Ninety per cent of the questionnaires sent to the parents were returned completely or almost completely answered. They revealed that 43.3 per cent of the parents knew of no diabetics among their relatives, while 56.7 per cent had diabetic relatives. Table 3 shows this incidence of the disease, which is about the same as that reported by Joslin (9, 11). The mean number of relatives having diabetes among cases reporting any incidence in the family was two. Diabetic subjects having diabetic siblings or parent numbered six (10 per cent of the total group). The only other physical abnormality reported for the families of our diabetic children to a greater extent than for the general population was some disturbance of the thyroid gland. This occurred in twenty-three of our cases.

TABLE 3

INCIDENCE OF DIABETES AND OTHER ENDOCRINE DISTURBANCES IN FAMILIES OF DIABETIC CHILDREN STUDIED

Relative	Cases of Diabetes	Cases of Other Endocrine Disturbances
Sibling	10	5
Parent	1	5
Parent's sibling	18	10
Grandparent	6	3
Grandparent's sibling	11	1
Other relative (including great-grandparent, cousin, etc.)	21	1
Total incidence in families	67	20

Physique and health.[4] Although it is generally realized that the diabetic child as well as the diabetic adult is more susceptible than the normal person to degenerative processes (probably less true under the present diabetic regime than under former ones), only 10 per cent of our diabetic children were shown to have complications or any other disease of more than three months duration.

Except for a few complications of diabetes, our children, according to the findings on physical examination, were of normal physique and health. Approximately half of them, according to parents' reports, had enjoyed as good health as their siblings before the onset of diabetes, and during the year immediately preceding our study only two were reported as having been in worse health. Eighteen cases reported some acute infection other than colds in the six months preceding the onset of diabetes, the most numerous being measles, tonsillitis, and scarlet fever. The parents of seventeen diabetics reported that these children had had more colds than their siblings during the past year, while fifteen reported fewer colds for the diabetics and eight, the same number.

Mental development and ability. It was found that our group of diabetic children was distributed quite normally as to intelligence, as may be seen from Table 4. This shows that 43 per cent of the diabetics are within the average I.Q. range (90 to 110) with approximately equal numbers above and below.

TABLE 4

DISTRIBUTION OF I.Q.'s FOR DIABETICS AND SIBLINGS

I.Q.	Diabetics				Siblings		
	M	F	Total	Per cent	M	F	Total
140 or over		1	1	1.7	2		2
130-140	1	2	3	5.0		1	1
120-130	4	1	5	8.3	2	1	3
110-120	3	5	8	13.3	3	2	5
90-110	11	15	26	43.3	9	5	14
80-90	3	7	10	16.7	1	0	1
70-80	1	4	5	8.3			
50-70		1	1	1.7	1	1	2
Number	23	37	60		18	10	28
Median	102.63	95.34	99.5				106.25
Mean	103.5	98.9	100.65				107.00

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[4] This phase of the subject is more fully treated in my article "The Diabetic Child," in the American Journal of Diseases of Children.

Both the mean and the median I.Q. are almost exactly 100, as compared with a median I.Q. of 108 for the siblings. Joslin and White (9, 21) report in their special group of 169 diabetic children twice as many testing above 110 as below 90 on the "old" Stanford-Binet. The correlation coefficient of the I.Q. s of our diabetic group with those of their siblings is 51 ± .091. In our group there is no deviation from the normal in the range of year levels nor in the pattern of abilities and disabilities. In fact, the group as a whole is developed regularly and evenly in mentality. No relationship was found between duration or severity of the disease on the one hand and intelligence on the other.

In discussing a paper on Juvenile Diabetes read in 1927, both Drs. F. S. Smyth and H. F. West made references to the diabetic child as "precocious" and "superior" (mentally). Just prior to the advent of insulin, Miles and Root (16) studied forty of Joslin's adult diabetics. Although they remark that many were of good education, they record a decrement of about 15 per cent or more in memory and attention tasks and a decrease in span and speed, but no increase in errors. A more recent study of juvenile diabetics in California by West et al (20) concludes that they are above average intelligence, although an adequate description of the group was not given.

Results were not materially altered when we removed from our calculations six diabetics who had complications or other diseases which, it was felt, might have interfered with their educational progress. This group consisted of three children with rather severe ocular defects, two children with hypothyroidism, one of whom also has epilepsy, and one with lipoidystrophy. Three new cases, including two private patients -- all uncomplicated and all belonging to the two upper socio-economic groups-- were substituted, and the mean and median intelligence quotients for the reconstituted groups were calculated. The mean I.Q. was 102.35, the median 100.5.

Parents reports of their opinions of the children's present ability and achievement indicated that the diabetics were doing approximately as well in their school work as their siblings were, also that they were doing as well at present as they did before the onset of the disease. Only one diabetic was considered by his parents to be less bright and less efficient than his sibling.

It may be of interest to realize that there was only one diabetic in Terman s group of gifted children, and he had contracted the disease after reaching the age of fifteen (18). The high percentage of bright children in Joslin and White s (9, 21) diabetic group may be due in part to the high percentage of Jewish children among their cases (Terman (19) and others have found more than the expected number of Jewish children in gifted groups), and in part to the weighting by those patients from the upper socio-economic groups.

Personality. Ratings on the Woodworth-Cady Psycho-Neurotic Inventory (Table 5) show an approximately equivalent distribution for the diabetics and

TABLE 5

DISTRIBUTION OF RATINGS ON WOODWORTH-CADY PSYCHO-NEUROTIC INVENTORY
FOR DIABETICS AND SIBLINGS

Rating	Diabetics*		Siblings**	
	Number	Per cent	Number	Per cent
A	3	6.5	1	4.8
B	15	32.6	7	33.3
C	22	47.8	12	57.1
D	6	13.0	1	4.8
E	0	0	0	0
Total	46	100.0	21	100.0

*Median C.A., 14 years.
**Median C.A., 15 years 3 months.

their siblings. Neither group has a single case with an E rating (a decided deviation from the average in the direction of the neurotic), and few cases in either group come below the C, or normal, group. The fact that more diabetics than siblings have a rating of D may be due to the fact that some of the questions in the Inventory have to do with health, and this of course places the diabetics at a disadvantage.

Behavior of the diabetics as observed during the test situation showed little variation from the average. As many cases were found of extremely rapid mental functioning as of unusually slow mental functioning. There were a number of cases of physical sluggishness or stolid, phlegmatic temperament coupled with a normal or rapid rate of mental functioning. (These are typical Scandinavian traits). Carefulness, meticulousness, earnestness, and conscientiousness were noted an unusual number of times. This latter finding as well as the good school reports may, of course, be attributed to the habit-training forced on the diabetic child by the regimen of the disease.

All traits mentioned in the school reports were tabulated for both the diabetics and their siblings. While these traits do not lend themselves very well to quantitative treatment, it may be noted that desirable traits were listed for the diabetics half again as often as undesirable ones. Only twice was it reported that a diabetic child expected undue consideration on account of his disability, and only once that a child was sensitive about his condition. There was a surprising infrequency of mention of such traits as seeking attention and feeling inferior, which might well be expected to appear in a diabetic child.

Tables 6 and 7 summarize the parents' reports on the diabetic children's behavior. They indicate a prevailing opinion among the parents that the personality of the diabetics has been changed but little by the disease. Excitability and irritability are the only traits that show a considerable increase since the onset of diabetes, although there is some apparent increase in cautiousness and stubbornness. The former traits are also the only ones in which the diabetic child is considered by his parents to differ from his sibling to any appreciable extent. Virtually all the parents in the upper three socio-economic groups mention this increased excitability and irritability, so that it probably

TABLE 6

PARENTS' RELATIVE RANKING OF CERTAIN PERSONALITY TRAITS IN DIABETIC CHILDREN AT THE TIME OF THE STUDY AND PREVIOUS TO ONSET OF THE DISEASE

Personality Trait	Having Less of Trait		Having Same Amount		Having More	
	Number	Per cent	Number	Per cent	Number	Per cent
Activity, energy	8	22	19	51	10	27
Play	7	16	21	48	16	37
Work	10	23	20	47	13	30
Study	8	19	24	57	10	24
Persistence	7	16	22	51	14	33
Obedience	8	17	34	71	6	12
Stubbornness	6	13	21	47	18	40
Excitability	8	17	11	23	29	60
Irritability	4	8	14	29	31	63
Cheerfulness	6	12	33	69	9	19
Cautiousness	5	10	27	56	16	33
Earnestness, conscientiousness	5	11	26	54	14	31
Punctuality	8	17	25	54	13	28
Desire for attention	4	9	24	51	19	40
Being spoilt	9	21	25	58	9	21
Friendliness, sociability	3	6	27	58	17	36

is a real change and a more common one than the number reporting it would seem to indicate. This apparent increase in irritability may be caused in part by over-solicitiousness of the parents, in part by the child's fear of being considered inferior or different, and in part by the disadvantages or hardships forced on him by the disease. It is probably no more marked in diabetes than in other chronic diseases.

TABLE 7

COMPARISON OF CERTAIN PERSONALITY TRAITS IN THE DIABETIC CHILD
AND HIS SIBLING CONTROL

Personality Trait	Much Less		Less		Same		More		Much More	
	No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent
Activity, energy	1	4	4	16	14	56	3	12	3	12
Play	1	3	6	18	18	55	4	12	4	12
Work			3	9	14	42	13	39	3	9
Play			6	21	11	38	10	34	2	7
Persistence			3	9	20	59	7	21	4	12
Obedience			7	18	23	61	5	13	3	8
Stubbornness			10	20	18	47	7	9	3	9
Excitability			6	16	15	40	10	5	7	19
Irritability			8	21	12	32	13	34	5	13
Cheerfulness	1	3	2	5	25	66	8	21	2	5
Cautiousness			5	14	17	47	12	33	2	6
Earnestness			3	9	18	55	8	24	4	12
Punctuality			5	15	19	56	8	24	2	6
Desire for attention			7	19	22	61	7	19		
Being spoilt			5	15	21	64	4	12	3	9
Friendliness			4	11	22	63	6	17	3	9

It is important for the sake of the personality of the diabetic child that not too much attention or sympathy be bestowed on him by parents, teachers, or friends, in case he thus may come to feel different from other children and to expect privileges on account of his illness. He should be given the responsibility for his own welfare (testing his urine and giving his own insulin) as early as possible, and he should be made to feel that success depends upon himself in the matter of his total well-being.

SUMMARY AND CONCLUSIONS

Sixty diabetic children from two Minneapolis hospitals were studied to determine whether or not they differed significantly in physique, intelligence, or personality from non-diabetic children. Objective comparisons were made between twenty-eight diabetic children and an equal number of their siblings and subjective comparisons between forty-eight of the diabetics and their siblings. For the final determination of the mean intelligence quotient, the scores of six diabetics who had complications which might possibly have lowered their I.Q. were excluded, and three cases, selected in such a way as to make the socio-economic distribution of the whole diabetic group more representative, were added. These included two of the five private cases of diabetic children that could be found in Minneapolis.

From this study the following conclusions may be drawn:

1. The original group is typical of the diabetic clinic population of the two hospitals from which the cases were taken.
2. The modified group is representative of the children of Minnesota.
3. There is a wide distribution of cases in regard to location in the state, age of the children, and the duration and severity of the disease.

4. The group contains an unexplained preponderance of girls.

5. The group shows no deviation from the general average in intelligence and no significant deviation from the average for their own siblings or from the average for Minneapolis children.

6. School achievement and behavior of our diabetic group compared favorably with that of their siblings, in spite of poorer attendance. This may be explained in part perhaps by a transfer of the good habits inculcated in the diabetic by his doctor and his parents in regard to the physical care of the disease.

7. Increased irritability and excitability are the only significant personality changes noted by the parents and no significant deviations are noted in the school or testing situations.

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THE USE OF COMMANDS, SUGGESTIONS, AND REQUESTS BY NURSERY SCHOOL AND KINDERGARTEN TEACHERS

SALLIE BETH MOORE[1]

In 1853, the Reverend James O, Andrew (1) wrote, "If you expect your children to succeed well in any of the walks of useful and honourable life, you must by all means seek to awaken within them a spirit of independence. Even from early childhood let them learn to wait on themselves." Also he advises parents to "take some pains and trouble in explaining matters" to children. "Let your commands be reasonable, and wisely adapted to age and time and circumstance."

The most up-to-date books on child psychology offer virtually identical advice. Blatz and Bott (2) say that few commands should be given, and that these should be voiced clearly and simply, with reasons whenever possible. Faegre and Anderson (6) agree with this view, and add the caution that commands and suggestions be given only when one is sure the child hears. Myers (14) states that we rarely need to command--requests are better. Thom (16) suggests that teachers give a few, well-thought-out commands and see that they are fulfilled. Foster and Headley (8) point out that a command implies that the one commanded must have his thinking done for him, whereas a suggestion implies that the one to whom it is made has the ability to think for himself.

As to positive commands as opposed to negative ones, it is a well-known fact that for years child psychologists have been adjuring parents and teachers not to say "don't" to children. Groves (10) declares that almost any negative command can be translated into a positive one, and Foster and Headley (8) say that if positive suggestions are made to children there will be little need for commands.

The tone of voice and enunciation used in addressing children is also considered important. Blatz, Millichamp, and Fletcher (3) say, "children should always be spoken to slowly and quietly and in matter-of-fact tones"; Rand, Sweeney, and Vincent (15), "enunciate slowly and clearly to be sure the child follows you"; and Gruenberg (11), "speak to children kindly and quietly, much as you would address a grown-up person."

The importance of following up commands or suggestions to see that the child actually carries them out is emphasized by Faegre and Anderson (6), Foster and Headley (7), Blatz and Bott (2), and Brill and Youtz (4), the consensus of opinion being summed up in the statement of the last-named writers that "a command that is not obeyed is worse than no command at all."

Presumably all these excerpts from the professional literature on child training are familiar to nursery school and kindergarten teachers. To what extent do they practice the doctrines they have been taught? This study was devised in order to determine the distribution of commands, suggestions, and requests used by trained teachers in a specific nursery school and kindergarten, and to study the effect of various factors on the use of commands, suggestions, and requests.

Review of the Literature. Studies of this type are comparatively new in the history of child psychology. One of the first was made by Deadman (5), who observed two teachers in the University of Chicago Nursery School, discussed with them their theories of adult-child relationships, and formulated a set of ten principles for giving directions to young children. In 1928 Vaughn (17) made a study of the effects of various kinds of instruction in controlling a

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[1] From the Institute of Child Welfare, University of Minnesota.

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child's behavior. He concluded that the most effective way of obtaining obedience from children was to accompany one's instructions by adequate reasons. Foster (7) in 1929 observed nursery school and kindergarten children and teachers and noted the various amounts of time given by the teachers to each of the children. Johnson (12) in 1935 investigated the influence upon children's behavior of different types of commands and suggestions. She concluded that positive, unhurrying, specific, and encouraging types of instruction are more effective than their opposites.

McClure (13) in 1930 made a very interesting study of the effect of varying verbal instructions on the motor responses of preschool children. She found that encouragement was more effective than discouragement, also that the order in which the command or suggestion was presented, the age of the child, and the desirability of the task all had an effect on the child's responses.

Subjects and Method. The present study was carried on in the nursery school and kindergarten of the Institute of Child Welfare, University of Minnesota. The subjects in the nursery school were 18 boys and 18 girls, ranging in chronological age from one year, eleven months to four years, nine months. Twelve were approximately two years old, twelve three years and twelve four years. Their I.Q.'s ranged from 89 to 135. In the kindergarten there were forty-two children, twenty-one of each sex, ranging in age from four years, eleven months to five years, ten months. Their I.Q.'s ranged from 75 to 140.

Observations of teacher-child relationships were made for a total of one hundred hours in the nursery school and for a total of twenty-nine hours in the kindergarten. Each of the full-time teachers in both the nursery school and the kindergarten was observed for the equivalent of four full days. The practice teachers were considered as a unit and were observed for the equivalent of four days.

A sample of the record blank used is given below:

Name of Child (Sonny)   Name of Teacher (C)   Place (103)   Time 10:30-11:45   Date 4-7

Words spoken	Voice				Child's activity	Interest	Time		Not done	Repeat	TH
	S	O	St	E			Min.	Sec.			
Sonny, we are going upstairs now		x			Pulling toy on floor	4		3	x	1	

The letters under "Voice" indicate whether the tone used by the teacher was subdued, ordinary, stern, or extraordinary. The figure under "Interest" indicates the degree of the child's interest in his occupation, as estimated on a five-point scale. "Time" is the amount of time that elapsed before the child responded. A check under "not done" means that the child did not obey the teacher's instructions, and the figure under "repeat" is the number of times she repeated her command or suggestion. TH is "teacher help."

The teachers were told that the children were being observed and timed for their responses to commands, etc., but they were not told that their own words and tone of voice were being recorded.

Words spoken by the teachers to the children were classified as:

1. Commands. "Sit up." "Give it to Dickie."
2. Commands with reasons. "Go get your sweater, Verne. We are going outside now." "Put one of those back, Patty, for you need only one."
3. Negative commands. "Don't throw sand."
4. Suggestions. "Let's leave your sandwich here." "Mary, you haven't used your wash cloth."
5. Requests. "Margaret, will you take this downstairs?"

A few commands and suggestions given by gesture during the rest period--such as a teacher's placing her finger on her lip when a child was whispering--were not recorded, since the number was very small.

Age and Sex Differences. Table 1 shows the number and percentage of the various ways in which teachers gave instructions to children in each age group.

TABLE 1

NUMBER AND PERCENTAGE OF VARIOUS TYPES OF INSTRUCTION GIVEN CHILDREN IN EACH AGE GROUP

Age of Child	Commands		Commands With Reasons		Negative Commands		Suggestions		Requests		All
	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent	Number
2	295	55.3	67	12.5	2	.37	150	28.1	19	3.5	533
3	176	43.8	44	10.9	2	.49	150	37.4	29	7.2	401
4	230	41.4	53	9.5	3	.54	219	39.4	50	9.0	555
5	83	21.8	24	6.2	0	.00	203	53.2	71	18.6	381
Total	784		188		7		722		169		1870

In order to determine the significance of the difference in percentages, the standard deviation of the difference was obtained from Paterson and Edgerton's tables and the $\frac{\text{Diff.}}{\sigma \text{ diff.}}$ was calculated for each pair of age levels. These were as follows:

TABLE 2

$\frac{\text{DIFF.}}{\sigma \text{ diff.}}$ FOR VARIOUS INSTRUCTIONS GIVEN EACH AGE GROUP*

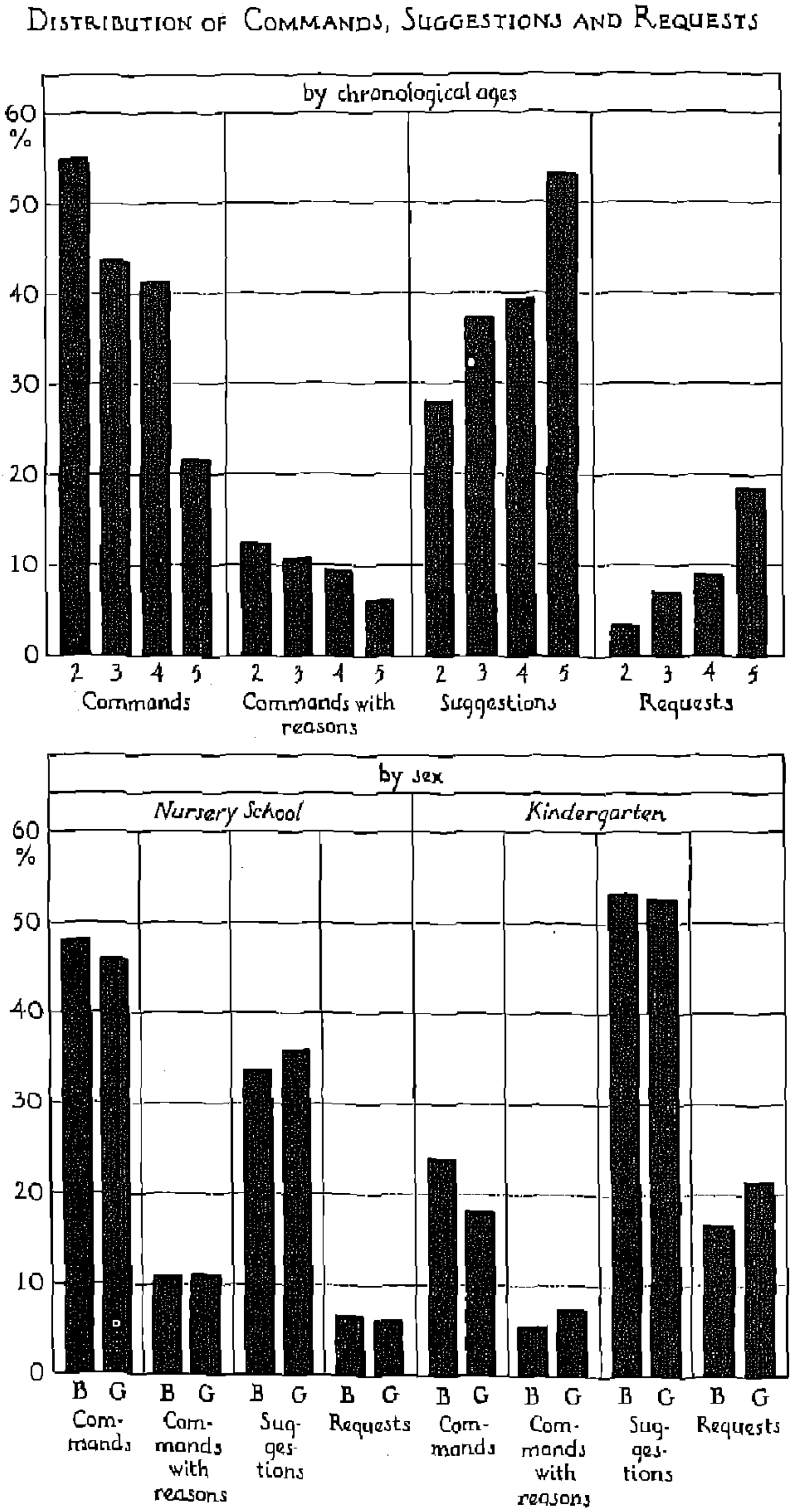
Ages	Commands	Commands with Reasons	Suggestions	Requests
2 and 3	3.46	.752	2.97	2.34
3 and 4	.735	.679	.627	.979
4 and 5	6.44	1.79	.368	4.02

*The percentage of negative commands was so small that the difference was not calculated.

Several interesting points may be observed in Table 1. For one thing, the percentage of commands given nursery school children decreased as the children grew older. There was a significant difference in the number given the two- and the three-year-olds, also in the number given the four- and the five-year-olds. The number of commands with reasons tended to decrease as the children grew older, but the difference was too slight to be significant. The number of suggestions increased consistently with the age of the child. Of all instructions given the two-year-olds, 28.1 per cent were suggestions; the three-year-olds, 37.4 per cent; the four-year-olds, 39.4 per cent, and the five-year-olds, 53.2 per cent, or more than half of all their instructions. The use of requests was also much greater at five years than at any preceding age. The percentage of requests at two years of age was only 3.5; at three, 7.2; at four, 9.0; and at five, 10.6. In view of child psychologists' general disapproval of negative commands it is also interesting to note that only seven were given during the one hundred hours observation in the nursery school and none during the twenty-nine hours observation in the kindergarten.

The sex differences in the various types of instruction given are shown in Table 3. It will be seen that in both the nursery school and the kindergarten the boys received slightly more commands than the girls. The differences are, however, slight and not significant. (This is similar to the finding of McClure.)

Figure 1 gives a graphic comparison of commands, suggestions, and requests for each age level and for boys and girls.



Distribution of Commands, Suggestions and Requests

Figure 1

TABLE 3

NUMBER AND PERCENTAGE OF VARIOUS TYPES OF INSTRUCTION GIVEN BOYS AND GIRLS IN NURSERY SCHOOL AND IN KINDERGARTEN

Sex of Children	*Commands*		*Commands With Reasons*		*Negative Commands*		*Suggestions*		*Requests*		*All*
	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent	Number
					Nursery School						
Boys	373	48.1	85	10.9	3	.38	262	33.7	53	6.8	776
Girls	328	46.0	79	11.1	4	.56	257	36.0	45	6.3	713
Diff. / σ diff.	.802		.117				.903		.371		
Total	701		164				519		98		1489
					Kindergarten						
Boys	56	24.0	13	5.5			125	53.2	39	16.7	233
Girls	27	18.2	11	7.4			78	52.7	32	21.5	148
Diff / σ diff.	1.36		.719				.095		1.16		
Total	83		24				203		71		381

Relation to Intelligence. I.Q.'s used in this study were derived from Form B of the Minnesota Preschool Scale, which is given to all children entering the nursery school or kindergarten at the University of Minnesota. In the nursery school the 36 children were divided into three groups of 12 each, the first group having an I.Q. range of 88 to 104, the second from 105 to 119, and the third from 120 to 135. In the kindergarten likewise the children were divided into three groups of 14 each, the first group having an I.Q. range of 75 to 100, the second from 101 to 111, and the third from 112 to 140.

In regard to this aspect of the study, it was found that none of the teachers paid much attention to the difference in the children's I.Q.'s. When the teachers were asked to group the children under the proper I.Q. division, Miss B placed 25 per cent wrongly, Miss C 27.8 per cent, and Miss A 55.5 per cent. Although the teachers have access to the children's I.Q. records, it is obvious that they do not make much use of them. Certainly the teachers were not consciously making any distinctions in addressing commands, suggestions, or requests to children of various mental capacities.

It is not surprising, therefore, that the experimenter found little difference in the distribution of the various types of instruction given to children of different I.Q. level. There were slightly more commands and commands with reasons used in the lowest I.Q. groups than in others, in both nursery school and kindergarten, while the number of suggestions and requests increased with the higher I.Q. levels. In both nursery school and kindergarten the middle I.Q. group received the smallest percentage of commands, suggestions, and requests. This may be because the lowest group needed more urging to finish a task while the highest group needed more suggestions as to new things to do. As shown in Tables 4 and 5, the differences throughout are slight and not significant. A graphic representation of these findings is given in Figure 2.

Relation to Socio-economic Status. In the nursery school there were children from Groups I, II, III, V, and VI of the Goodenough-Anderson Scale for Occupational Classification (9). Their distribution is shown in Table 6, which also shows the results when Groups I and II and Groups V and VI were combined in order that the total number in each group might be more even. Tables 7 and 8 and Figure 3 show how commands, suggestions, and requests were distributed among the various groups. In the nursery school the number of commands increased in the lower socio-economic brackets, while the number of suggestions decreased. More requests were used in the nursery school with the higher socio-economic groups, but fewer in the corresponding kindergarten

Distribution of Commands, Suggestions and Requests
by I. Q. Groups

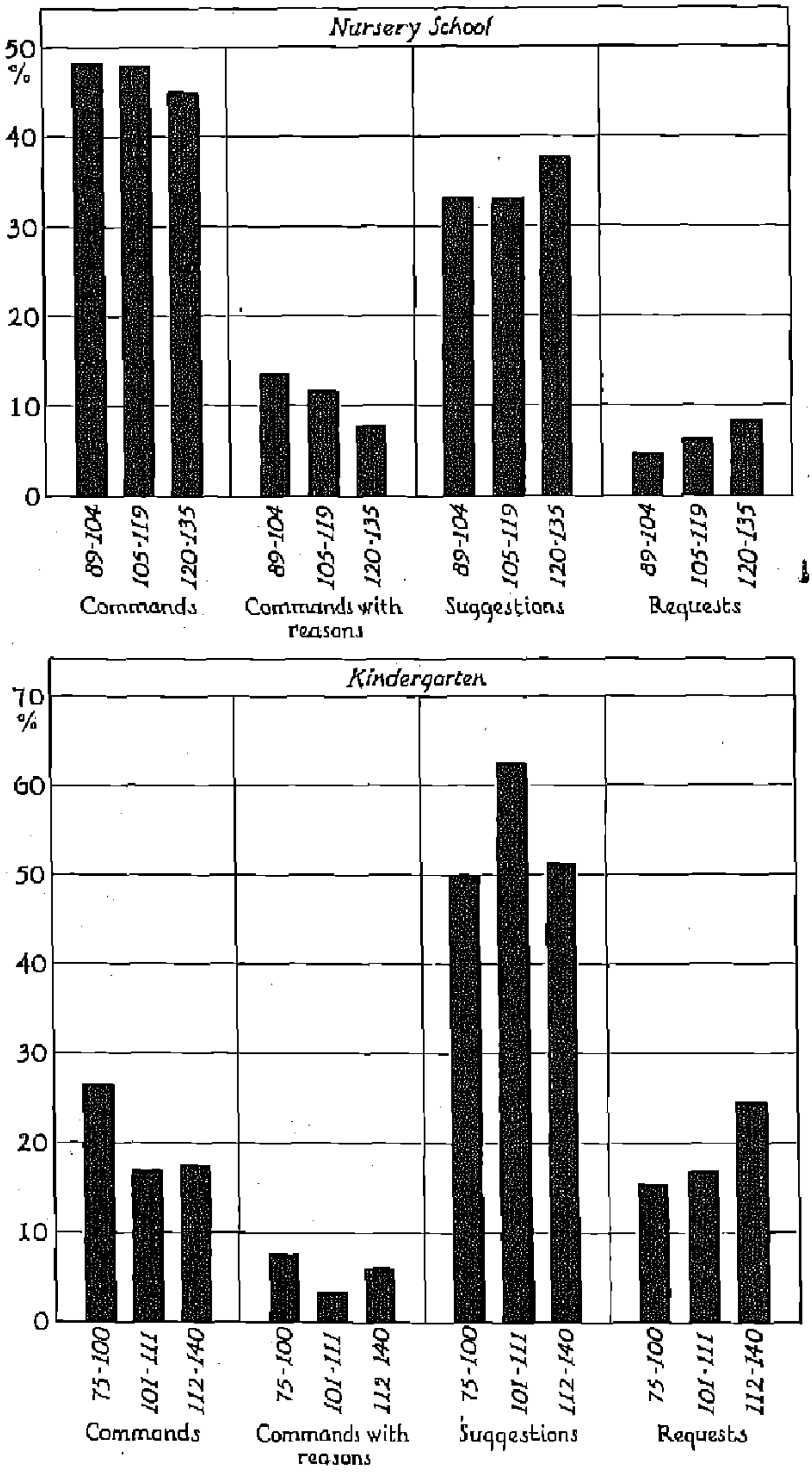


Figure 2

DISTRIBUTION OF COMMANDS, SUGGESTIONS AND REQUESTS FOR SOCIO-ECONOMIC GROUPS

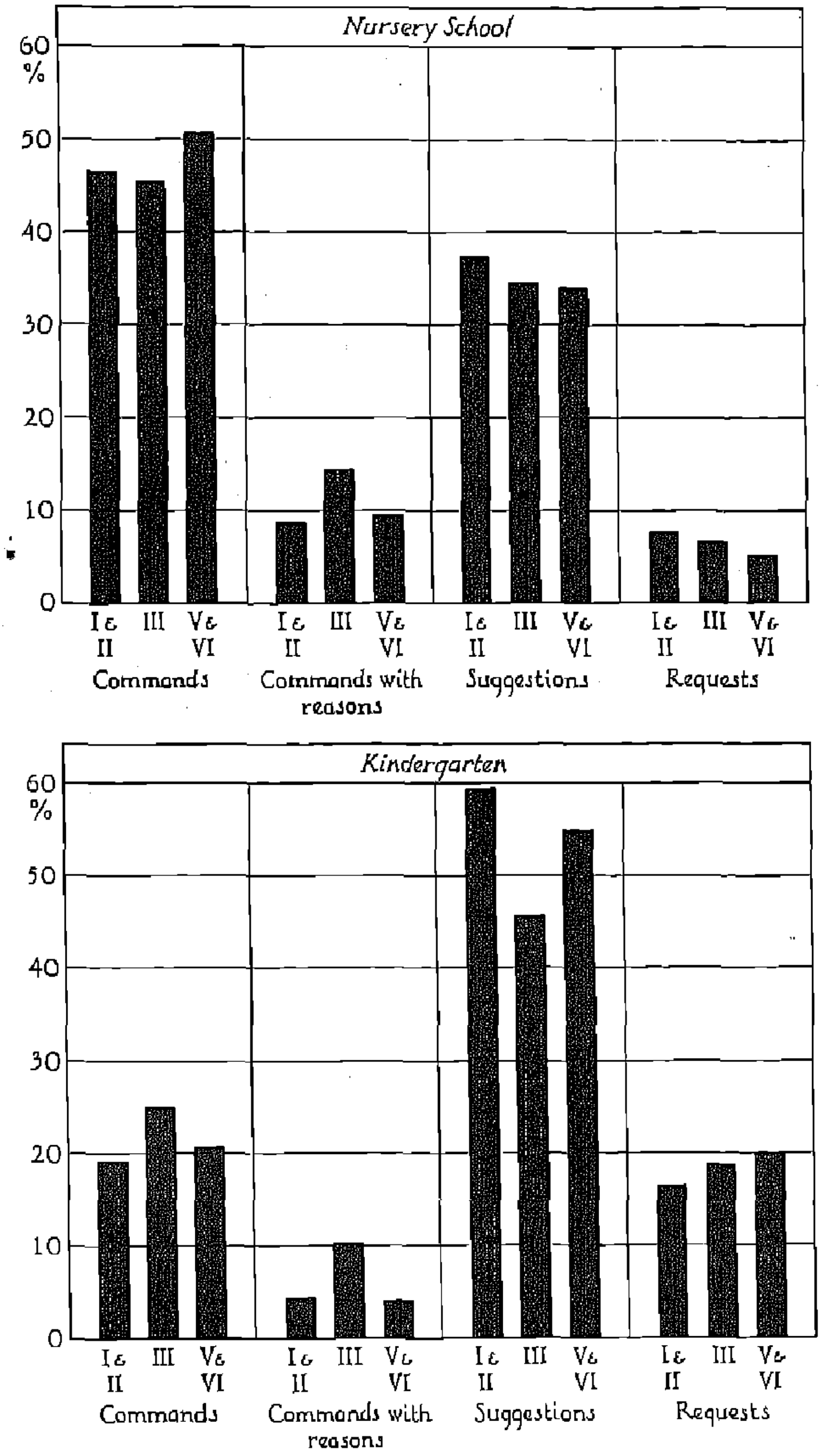


Figure 3

TABLE 4

NUMBER AND PERCENTAGE OF VARIOUS INSTRUCTIONS GIVEN
DIFFERENT I.Q. GROUPS

I.Q.	Commands		Commands With Reasons		Negative Commands		Suggestions		Requests		All	
	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent
					Nursery School							
89-104	244	48.2	69	13.6	1	.19	168	33.2	24	4.7	506	33.9
105-119	219	48.0	54	11.7	3	.65	151	33.1	29	6.3	456	30.6
120-135	238	45.1	41	7.7	3	.56	200	37.9	45	8.5	527	35.4
Total	701		164		7		519		98		1489	
					Kindergarten							
75-100	48	26.6	14	7.7			90	50.0	28	15.5	180	47.2
101-111	15	17.0	3	3.4			55	62.5	15	17.0	88	23.0
112-140	20	17.6	7	6.1			58	51.3	28	24.7	113	29.7
Total	83		24				203		71		381	

TABLE 5

$\frac{\text{DIFF.}}{\sigma\ \text{diff.}}$ FOR VARIOUS INSTRUCTIONS GIVEN DIFFERENT I.Q. GROUPS

I.Q. Groups	Commands	Commands With Reasons	Suggestions	Requests	All
		Nursery School			
Low and middle	.60	.839	.032	1.02	1.085
Middle and high	.89	2.17	1.59	1.24	1.57
Low and high	.996	2.95	1.58	2.317	.505
		Kindergarten			
Low and middle	1.83	1.51	1.94	.503	4.17
Middle and high	.109	.905	1.597	1.328	1.076
Low and high	1.815	.513	.215	1.853	3.08

TABLE 6

DISTRIBUTION OF SUBJECTS IN SOCIO-ECONOMIC GROUPS

Socio-Economic Group	Nursery School	Kindergarten	Combined Groups	Nursery School	Kindergarten
I	7	7	I and II	11	14
II	4	7			
III	12	14	III	12	14
V	9	10			
VI	4	4	V and VI	13	14

group. None of the differences is significant in either the nursery school or the kindergarten.

Relation to Time of Day. There is a significant difference in the number of commands, suggestions, and requests given in the nursery school at different hours of the day during the two free-play periods. More commands and commands with reasons were given during the afternoon period, whereas more suggestions and requests were given in the morning. Two factors may enter into the explanation of these findings; first, the fact that both teachers and children were fresher during the morning; second, the fact that in the afternoon some of the children were drowsy after their naps, and consequently perhaps slower to respond.

TABLE 7

NUMBER AND PERCENTAGE OF VARIOUS TYPES OF INSTRUCTION GIVEN MEMBERS OF EACH SOCIO-ECONOMIC GROUP

Socio-Economic Group	Commands		Commands With Reasons		Negative Commands		Suggestions		Requests		All
	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent	Number
Nursery School											
I and II	233	46.6	44	8.8	6	1.2	177	37.4	39	7.8	499
III	212	45.5	72	14.4	1	0.2	169	34.7	33	6.7	487
V and VI	256	50.8	48	9.5			173	34.2	26	5.1	503
Kindergarten											
I and II	21	19,2	5	4.5			65	59.5	18	16.5	109
III	32	25.1	13	10.2			58	45.6	24	18.8	127
V and VI	30	20.7	6	4.1			80	55.1	29	20.0	145

TABLE 8

$\frac{\text{DIFF.}}{\sigma \text{ diff.}}$ FOR VARIOUS INSTRUCTIONS GIVEN DIFFERENT SOCIO-ECONOMIC GROUPS

Socio-Economic Group	Commands	Commands With Reasons	Suggestions	Requests
Nursery School				
High and middle	.338	2.717	.867	.621
Middle and low	1,629	2.304	.164	1.025
High and low	1,054	.366	1.052	1.646
Kindergarten				
High and middle	1.083	1.716	2.112	.458
Middle and low	.850	.125	.714	.717
High and low	.294	.014	.689	.577

By combining the two free-play periods, a three-hour period was obtained. This was compared with the three-hour period in the middle of the day (10.30 to 1.30), which is directed by the teacher. It was found that almost as many commands, suggestions, and requests were given during free play as during teacher-directed activities.

In the kindergarten there were two different groups of children, one meeting in the morning and the other in the afternoon. Since the two sessions are not of the same length, they cannot be compared. In Table 9, therefore, the *morning and afternoon sessions of the kindergarten have been grouped together* and the two free-play periods of the nursery school have been grouped together. Figure 4 shows the distribution of commands, suggestions, and requests used with the nursery school children (a) at different hours of the day and (b) during free-play periods as compared with teacher-directed play periods. (F= free play; D= teacher-directed play.)

Repetitions. The teachers observed in this study had evidently mastered the art of obtaining obedience from children without repeating instructions. Of the 1,489 commands, suggestions, and requests given in the nursery school there were only 80 repetitions, or 5.3 per cent. In the kindergarten there were only 5 repetitions out of a possible 381, or 1.5 per cent. The three-year-olds needed fewer repetitions than did the two- or the four-year-olds, while the five-year-olds needed the least number of repetitions. Boys in nursery school required 6.4

DISTRIBUTION OF COMMANDS, SUGGESTIONS AND REQUESTS AT DIFFERENT TIMES OF DAY

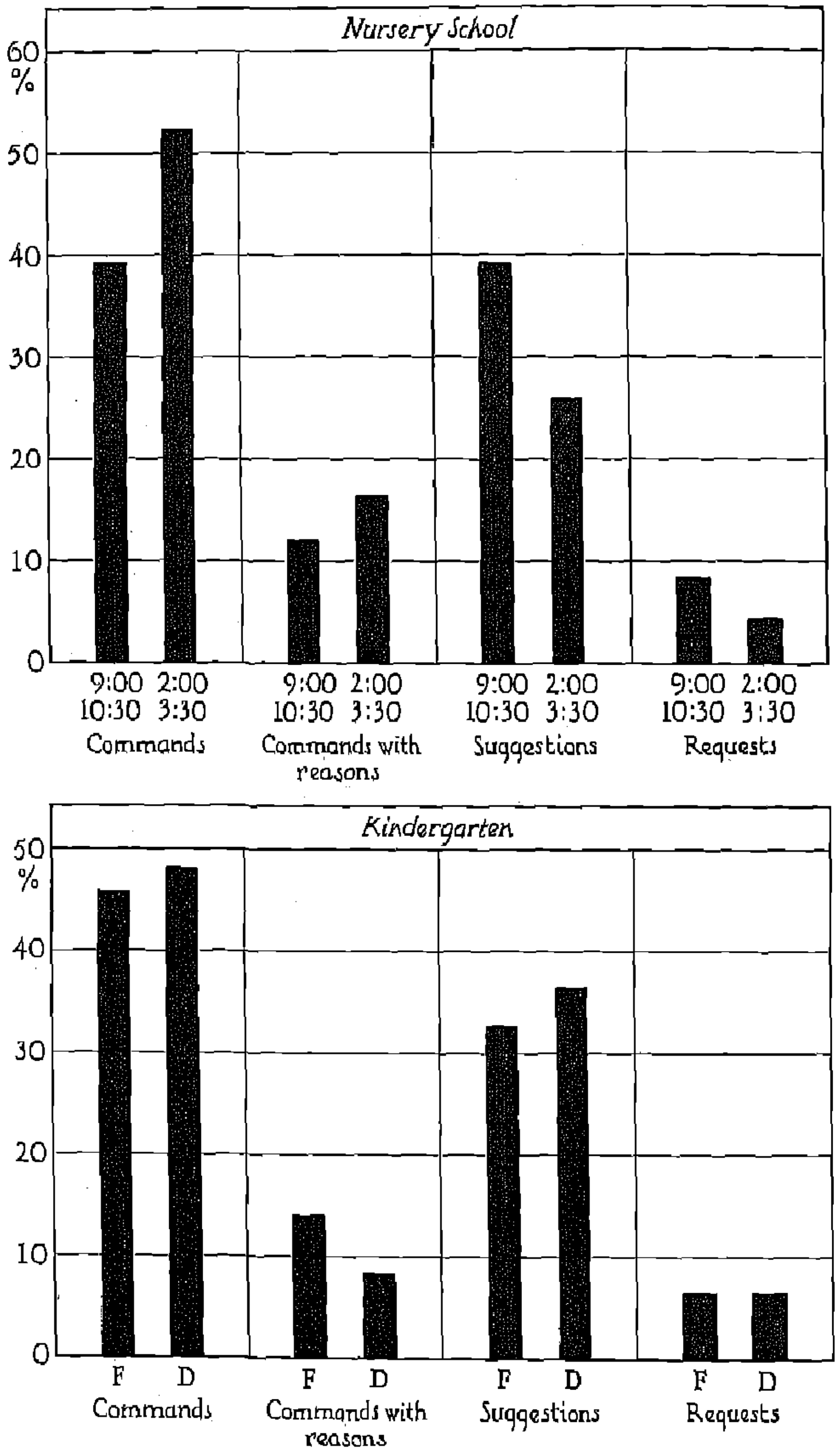


Figure 4

TABLE 9

NUMBER AND PERCENTAGE OF VARIOUS TYPES OF INSTRUCTION GIVEN AT DIFFERENT TIMES OF THE DAY

Time of Day	Commands		Commands With Reasons		Negative Commands		Suggestions		Requests		All
	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent	Number
					Nursery School						
9-10:30	134	39.3	41	12.1	2	.5	134	39.3	29	8.5	340
2-3:30	175	52.3	55	16.4	2	.5	87	26.0	15	4.4	333
Diff. / σ diff.	3.34		1.55				3.68		2.05		
					Kindergarten						
10:30	309	45.8	96	14.2	4	.5	221	32.7	44	6.5	674
1:30	392	48.2	68	8.3	3	.3	298	36.5	54	6.6	815
Diff. / σ diff.	2.37		3.43				1.49		.074		

per cent of their instructions to be repeated, girls only 4.2 per cent. In the kindergarten, on the other hand, girls required 2.8 per cent repeated, boys only .4 per cent. None of the differences is significant. It is a notable fact that even among the very young children in the nursery school only 5.3 per cent of all commands, suggestions, and requests needed to be repeated, and in the kindergarten only 1.5 per cent. The correlation between the number of instructions given each child per day and the number of repetitions required is .45 ± .0938.

Obedience. Equally striking is the record for obedience. Table 10 shows that only 5.9 per cent of all instructions given were not carried out. The two-

TABLE 10

NUMBER AND PERCENTAGE OF INSTRUCTIONS "NOT DONE" BY CHILDREN OF VARIOUS AGES IN NURSERY SCHOOL

	Age 2	Age 3	Age 4	All Ages
Commands				
Number given	295	176	230	701
Number not done	16	6	14	36
Percentage not done	5.4	3.4	6.1	5.1
Commands with reasons				
Number given	67	44	53	164
Number not done	4	2	6	12
Percentage not done	6.0	4.6	11.3	7.3
Suggestions				
Number given	150	150	219	519
Number not done	13	7	15	35
Percentage not done	8.7	4.7	6.9	6.7
Requests				
Number given	19	29	50	98
Number not done	0	0	6	6
Percentage not done	0.0	0.0	12.0	6.1
All instructions				
Number given	533	401	555	1489
Number not done	33	15	41	89
Percentage not done	6.1	3.7	7.3	5.9

and the four-year-olds both exceeded the three-year-olds in the percentage of instructions not complied with. This is in harmony with Foster's (7) finding that three-year-olds took less of the teacher's time than did children at the other two ages.

TABLE 11

NUMBER AND PERCENTAGE OF "TEACHER HELPS" GIVEN CHILDREN OF VARIOUS AGES IN NURSERY SCHOOL

	Age 2	Age 3	Age 4	All Ages
Commands				
Number given	295	176	230	701
Number teacher helps	50	21	17	88
Percentage teacher helps	16.9	11.9	7.3	12.5
Commands with reasons				
Number given	69	44	53	164
Number teacher helps	14	4	8	26
Percentage teacher helps	20.9	9.0	15.0	15.8
Suggestions				
Number given	150	150	219	519
Number teacher helps	33	25	25	83
Percentage teacher helps	22.0	16.6	11.4	15.9
Requests				
Number given	19	29	50	98
Number teacher helps	2	3	1	6
Percentage teacher helps	10.5	10.3	2.0	6.1
All instructions				
Number given	533	401	555	1489
Number teacher helps	99	53	51	203
Percentage teacher helps	18.5	13.2	9.1	13.6

TABLE 12

$\frac{\text{DIFF.}}{\sigma\text{diff.}}$ FOR TEACHER HELP GIVEN CHILDREN OF VARIOUS AGES IN NURSERY SCHOOL

Ages	Commands	Commands With Reasons	Suggestions	Requests	All
2 and 3	1.502	1.804	1.199		2.205
3 and 4	1.522	.920	1.368	1.396	1.916
2 and 4	3.453	.843	2.618		4.391

It was found that two-year-olds had to have suggestions repeated to a greater degree than did any other group and also that they left more suggestions undone than did the children of other ages. This may indicate that a two-year-old has not developed enough reasoning power to listen to a suggestion, think what to do, and then do it. The greatest number of instructions of all kinds left undone was found among the four-year-olds. This may have been due to the fact that the four-year-old child is interested in many things and hence his attention may wander from the carrying out of instructions in one activity to an entirely different matter. The comparatively large number of requests "not done" by the four-year-olds --12 per cent-- may be accounted for by the fact that teachers were following the suggestion of Myers in treating a request as a request: "If a child is asked, 'Would you like to shut the door?' and he says no, do not make him."

When the two sexes were compared in the matter of obedience, it was found that of the total number of commands, suggestions, and requests used in the nursery school, 5.9 per cent were left undone by boys and 6 per cent by girls. The difference is small and not significant. The rank order correlation between the number of instructions given and the number "not done" was .391 ± .098.

Teacher Help. There is a significant relation between the amount of "teacher help" given in the nursery school and the age of the child, the amount of help decreasing with age. An exception is found, however, in the case of commands with reasons, on which the four-year-olds received more help than the three-year-olds. It is worth while to note that of the 1,489 instructions of all types given in the nursery school, only 203 or 13.6 per cent were carried out with the help of the teacher; in other words, the children were helped very little and were encouraged to do things for themselves. There were no cases of teacher help in the kindergarten.

There was little difference in the amount of help given to boys and to girls, boys receiving help on 97 of 776 instructions, or 15.4 per cent, girls on 106 of 713 instructions, or 14.8 per cent. The differences are not significant. The rank order correlation between the number of instructions given per child per day and the number that had teacher help was .50 ± .086.

Tone of Teachers' Voices. The "extraordinary" voice was not noted at all during the observations. The ordinary speaking voice was used in giving 91.8 per cent of all instructions in the nursery school, the subdued voice in 6.4 per cent, and the stern voice in only 1.6 per cent. The ordinary voice was used during the entire period of observation in the kindergarten.

Comparison of Teachers. There was no significant difference in the percentage of commands, suggestions, and requests used by the four nursery school teachers. They all put the majority of their instructions to the children in the form either of commands or of suggestions, as Table 13 shows. Miss C, who was teaching for the first time, having been graduated only the previous year, gave a slightly larger percentage of commands than did any of the other teachers, and used more commands than any other type of instruction. Miss D, a practice teacher in her senior year at college, gave a larger percentage of suggestions than did any of the other teachers, also she gave more directions in the form of suggestions than in any other form.

TABLE 13

NUMBER AND PERCENTAGE OF VARIOUS INSTRUCTIONS GIVEN BY THE FOUR NURSERY SCHOOL AND TWO KINDERGARTEN TEACHERS

Teacher	Commands		Commands With Reasons		Negative Commands		Suggestions		Requests		All
	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent	Number
Nursery School											
Miss A	146	48.0	25	8.1	1	.3	107	34.9	26	8.4	305
Miss B	188	49.3	48	12.5	3	.7	113	29.3	29	7.6	381
Miss C	225	51.6	58	13.3	0	0	138	31.6	15	3.4	436
Miss D	142	38.6	33	8.9	3	.8	161	43.8	28	7.6	367
Total	701		164		7		519		98		1489
Kindergarten											
Miss E	58	36.0	13	8.0			56	34.7	34	21.1	161
Miss F	25	11.3	11	5.0			147	66.8	37	16.8	220
Total	83		24				203		71		381
$\frac{\text{Diff.}}{\sigma\ \text{diff.}}$	2.803						4.28		.459		

In the kindergarten Miss E, the assistant teacher, used almost the same percentage of suggestions as of commands, while Miss F, the full-time teacher, used six times as many suggestions as commands. A personality difference may be indicated by these differences which are shown graphically in Figure 5.

There was no significant difference among the teachers in the number of instructions they repeated. The number "not done" by the children decreased with the amount of teaching experience the teacher had had. With Miss D, the practice teacher, the children failed to respond to 34 instructions; with Miss C, the teacher with less than a year's experience, the number was 29; with Miss B, who was teaching for the second year, it was 16; and with Miss A, who had taught for several years, it was only 11. There were not enough cases, however, for these differences to be significant.

The varying amounts of teacher help given the children were not significant except for Miss B and Miss C. Miss B gave less help than the other three teachers, giving help in only 6.8 per cent of all possible situations. Miss C gave slightly more, helping the children in 16.9 per cent of the possible situations. Miss A helped in 14.7 per cent, and Miss D in 15.8 per cent. These slight variations may have been due to differences in personality, training, or experience.

Length of Time Taken to Respond. Foster and Headley (8) have pointed out that, while there is little difference in the length of time taken by children to respond to commands and to suggestions, a suggestion presents a problem to the child, whereas a command gives a solution. The children in this study took a median time of 6 seconds to respond to commands, 3.5 seconds for commands with reasons, 3.6 for suggestions, and 4.5 for requests.

As stated earlier, the interest of the child in his activity when addressed by the teacher was noted on a five-point scale, the higher ratings indicating the greater degrees of interest. Table 14 shows the mean length of time taken by the children to respond to instructions of all kinds, according to the degree of the child's interest in his activity at the time the instruction was given.

TABLE 14

MEAN NUMBER OF SECONDS ELAPSING BEFORE CHILDREN RESPONDED TO INSTRUCTIONS, ACCORDING TO DEGREE OF INTEREST IN ACTIVITY AND PERCENTAGE OF INSTRUCTIONS GIVEN AT EACH DEGREE OF INTEREST

Degree of interest	Percentage of Instructions at this Degree of Interest	Mean Number of Seconds before Child Responded
	Nursery School	
1	39.3	5.7
2	38.8	6.2
3	11.0	15.7
4	6.4	20.6
5	4.2	21.0
	Kindergarten	
1	7.4	2.16
2	26.3	2.9
3	25.7	4.1
4	17.8	3.3
5	23.7	5.4

It is readily apparent that the greater was the child's interest in his activity, the slower was his response to instructions. The interval before response was shorter in kindergarten than in nursery school children. The rank order correlation between the number of instructions given per child per day and the mean length of the interval before response was .34 ± .104.

DISTRIBUTION OF COMMANDS, SUGGESTIONS AND REQUESTS AS GIVEN BY TEACHERS

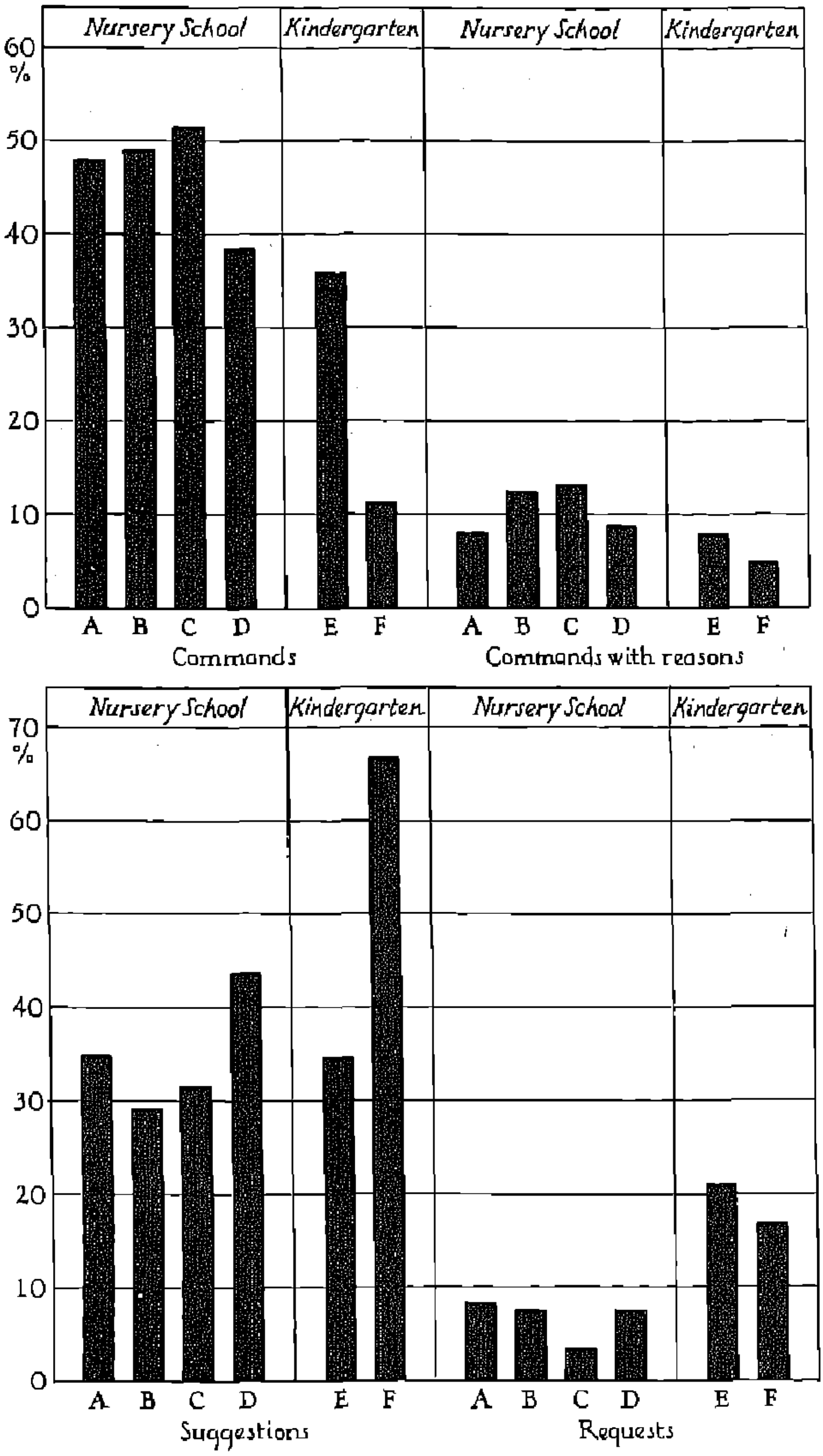


Figure 5

CONCLUSIONS

1. The number of commands and commands with reasons decreased with age, and the number of suggestions and requests increased. Few negative commands were given in the nursery school and none in the kindergarten.

2. There was little difference in the number of commands, suggestions, and requests given to boys and to girls respectively. More commands with reasons were used with the lower I.Q. groups, while more suggestions and requests were used with the higher I.Q. groups. This was apparently unintentional on the part of the teachers. There was no significant difference in the distribution of commands, suggestions, and requests among the different socio-economic groups.

3. The number of commands and commands with reasons was greater in the afternoon, while the number of suggestions and requests was greater in the morning. There was no significant difference between the number of instructions given during free play and the number given during teacher-directed play in the nursery school.

4. Only 5.3 per cent of all commands, suggestions, and requests given were repeated in the nursery school, and only 1.2 per cent in the kindergarten.

5. Only 5.9 per cent of all instructions given were left undone. The two- and the four-year-old children left more undone than did the three-year-olds. There was little sex difference.

6. The amount of teacher help given in carrying out instructions decreased with the age of the child. Only 13.6 per cent of all instructions were given teacher help.

7. The median length of time before a child responded to suggestions was shorter than the time for response to commands and requests. The mean length of time before the child responded to instructions varied directly with his interest in the activity in which he was engaged at the time of being addressed.

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STUDIES ON DENTAL CARIES
VI. CARIES EXPERIENCE AND VARIATION IN THE TIME OF ERUPTION OF THE PERMANENT TEETH[1]

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INTRODUCTION

Variability in the time of eruption of the permanent teeth is generally recognized as a normal characteristic of the growth and development of children.[2] Accordingly, any representative group of children may be expected to include some who may be characterized as "early eruptors", and others who may be characterized as "late eruptors". Such a group of children will include also some who are relatively susceptible and others who are relatively immune to dental caries. Systematic analyses of the constitution of the caries problem in children would appear to require, therefore, an inquiry as to whether or not any association exists between early or late eruption, *per se*, and attack of the teeth by the carious process.

Such an inquiry is pertinent for additional reasons. Thus it might be postulated that early eruption of the teeth implies a biological phenomenon analogous to the premature birth of children. With this postulate in mind, early eruption might be considered to contribute to a critical immaturity in the final stages of the development of the teeth. On the other hand, late eruption may be postulated as being consistent with full maturation in the development of the dental structures. The implications of these remarks take on special significance in the light of the suggestion that morphological maturation of the tooth surface might constitute a critical point in determining attack by, or resistance to, caries. While there is some evidence that gross hypoplasias of the teeth are not associated with increased liability to attack by caries, (1, 2, 3,) other evidence, chiefly adduced by Mellanby (4, 5,) would support the view that microscopic imperfections in crown development may be a factor in susceptibility to caries. It must be acknowledged that the Mellanby hypothesis is largely predicated on the assumption that such imperfections of the teeth are directly the result of dietary deficiencies. The perspective of the present discussion, it should be pointed out, would include the view that such imperfections may arise also because of other basic biological processes. A test of the validity of this hypothesis would appear to require an analysis of the relation of early and late eruption to the level of caries experience in appropriately selected groups of children.

Another reason for attempting to understand, in a quantitative sense, the possible relationship of the time of tooth eruption and caries experience, is predicated on observations included in a recently published paper (10) which indicate that significant familial relationships exist in the level of caries experience of children as well as in the time characteristics of tooth eruption. Since it is apparent that familial factors influence both caries experience and time of eruption of the teeth, the relation between these two latter variables, *per se*, becomes of some importance in analyses of the caries problem.

These considerations lead to the conclusion that in order to understand basic differences in the caries experience of different groups of children it is necessary to know whether or not differences in the time sequences of eruption of the teeth materially influence their caries experience.

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[1] From Child Hygiene Investigations, Division of Public Health Methods, National Institute of Health, U. S. Public Health Service.

[2] In a recent publication (7) it has been shown that this variability, in respect to the age distribution of eruption, may be described by the normal probability function.

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MATERIAL AND ANALYSIS

Preliminary Considerations. A direct approach to the problem presented in the introduction of this paper, would appear to require observations on the time of eruption of the teeth, together with clinical histories regarding the attack of these teeth by caries. The collection of such data implies a longitudinal or seriatim study and, since observations of this character are very difficult to obtain, it has seemed worth while to attempt to develop a method involving an indirect approach. The essential feature of this attempt to develop a methodology concerns a classification of children with respect to a characteristic which may be defined for present purposes as the "earliness" or "lateness" of the eruption of the permanent teeth. This classification is based on the hypothesis that the relative earliness or lateness of the time of eruption is highly correlated, at any specified chronological age,[3] with a count of the total number of erupted permanent teeth. For example, a child of eight years of age who has only six permanent teeth erupted may be classed as a late eruptor in comparison with another child of eight years who has 16 teeth erupted. Extension of this concept leads immediately to a recognition of the fact that an orderly arrangement of children of a given chronological age, according to the number of permanent teeth erupted into the mouth, also gives indirectly an orderly arrangement of the children with respect to the relative time of appearance of their teeth. Thus in a group of children of the same age, those with the fewest erupted teeth may be designated late eruptors; those with the greatest number of erupted teeth as early eruptors. In connection with this discussion, it is pertinent to point out that the assumption is made that children of the same age having the same total number of erupted teeth are considered identical with respect to the time of eruption of these teeth. As a corollary also it is obvious that this method of estimating relative dates of eruption is not applicable at young ages when most children have no erupted permanent teeth or at older ages when most children have nearly all of their teeth erupted.

A second important topic which requires discussion concerns the method of measuring quantitatively the attack of the teeth by caries. Thus it is necessary to recognize that an important difference between children whose teeth erupt early and children of the same age whose teeth erupt late is that the teeth of the former will have been exposed to the environment of the mouth, and therefore to the risk of attack by caries, longer than the teeth of the latter. Any attempt to determine whether or not early or late eruption, per se, is associated with difference in liability to attack by caries must take into account and control this factor of differential exposure. A method for determining the length of time the permanent teeth are exposed in the mouth, accumulated post-eruptive tooth age, has been described in a previous publication (8). By the application of the technique given in this reference, the caries experience of different groups of children can be expressed directly in terms of post-eruptive years of exposure of the teeth in the mouth.

A third important general point which requires consideration involves the fact that analysis must be made specific for the different morphological types of teeth. This requirement becomes obvious when it is indicated that relative susceptibility to attack by caries differs for the different types of teeth.[4] The measurement of total caries experience in a group of early eruptors as contrasted with a group of late eruptors would mean that comparisons were being made for heterogeneous populations of different kinds of teeth having different known levels[4] of relative susceptibility to attack by caries. In the light of this fact, the decision was made to limit the present investigation to a study of a single morphological type of tooth, the lower first permanent molar. This limitation of the study to data on the lower first molars is justified in part by the consideration that an association between the caries experience and the time of eruption of a single type of tooth *may* be taken as representative of the teeth in general. Furthermore, it is of some significance to indicate that the practical importance of this limitation of the study is somewhat lessened by the fact that approximately three-fourths of the caries experience of school children is found in the lower first molar (6).

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[3] See footnote 7.

[4] Details of a study on which these statements are based will be given in a subsequent communication.

This preliminary discussion of methodology may be summarized as follows: First, it is proposed to estimate quantitatively a characteristic defined as relative "earliness" and "lateness" of eruption of the permanent teeth from observations on the total number of erupted teeth. Second, a quantitative measurement of caries experience is to be expressed in terms of the length of time the teeth are exposed to the environment of the mouth, post-eruptive tooth age. Third, the present study is to be limited to an investigation of the association between the relative time of eruption of the lower first permanent molar teeth and the caries experience found in these teeth.

Material. Data suitable for the analysis of the relationship between time of eruption of the teeth and their attack by caries are afforded in records recently obtained in a dental survey of school children at Hagerstown, Maryland. Full details of the manner of collecting these data and the results obtained are to be found in previous publications (6, 7, 8, 9, 10,). In this place it may be stated that approximately 4,400 white children, comprising 94 per cent of the total enrollment of the municipal elementary schools, received in the spring of 1937 careful clinical dental examinations by dental officers in the employ of the United States Public Health Service. Records of these examinations contain observations on the number of permanent teeth erupted into the mouth and detailed descriptions of the location and specific surface involvment of the teeth by carious lesions. The examiners followed the arbitrary definition that a permanent tooth was erupted if the crown projected one millimeter or more above the margin of the gum. Carious lesions were those so designated on the basis of a careful clinical examination with mirror and sharp pointed pig-tail explorer. Pits and fissures in which the explorer caught were itemized separately and not designated as caries. For the permanent teeth caries experience was measured by means of a count of decayed, missing or filled (DMF)[5] teeth and tooth surfaces. In counting carious tooth surfaces, remaining roots and missing (extracted) permanent teeth were considered equal to five carious surfaces.

Analysis. The first step in the analysis made for the present study is indicated in the material presented in Tables 1, 2 and 3. Table 1 gives frequency distributions by age and sex groups of children classified according to the total number of permanent teeth erupted into the mouth. Table 2 gives the total number of erupted lower first permanent molars (both right and left) observed in the children classified as shown in Table 1. Following the same plan as used in the preparation of Table 2, Table 3 gives the number of the lower first permanent molars which have been attacked by caries (the number of DMF lower first permanent molars).

The next step in the analysis is concerned with subdividing into four categories the data for each age-sex group of children, each category representing a quartile subdivision of the frequency distribution of children arranged according to their number of erupted permanent teeth.[6] Categories entitled "first

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[5] For a full discussion of the DMF concept, see reference 11.

[6] Methods of subdividing a frequency distribution into quartile groups are given in most elementary textbooks on statistics; see, for example, Yule, G. and Kendall, M. An Introduction to the Theory of Statistics, p. 147. (11th Edition, 1937) Charles Griffin and Co.

TABLE 1

NUMBER OF CHILDREN HAVING SPECIFIED TOTAL NUMBERS OF PERMANENT TEETH ERUPTED. DATA DERIVED FROM DENTAL EXAMINATIONS OF ELEMENTARY SCHOOL CHILDREN, HAGERSTOWN, MARYLAND.

Total number of permanent teeth erupted	AGE (Years last birthday)										
	6	7	8	9	10	11	12	13	14	15	All Ages
					BOYS						
0	22	5									27
1	8	3									11
2	24	4	2								30
3	14	5	1								20
4	29	8	-								37
5	13	7	1								21
6	31	43	4	1							79
7	7	18	10	1							36
8	8	17	21	5							51
9	2	12	10	4	1						29
10	8	39	58	19	2						126
11	2	12	25	13	7	1					60
12	3	21	52	78	42	7	2	1			206
13	-	1	29	34	30	11	3	-			108
14	-	1	12	29	21	6	7	1			77
15	-	1	2	29	34	15	4	1			86
16	-	-	3	15	21	17	5	1			62
17	-	-	-	5	18	18	6	1			48
18	-	-	-	10	16	18	9	1			54
19	-	-	-	4	16	9	13	3	1		46
20	-	-	1	2	14	27	13	1	-		58
21	-	-	-	-	6	13	8	6	3	1	37
22	-	-	-	2	13	28	24	5	3	-	75
23	-	-	-	2	9	18	26	3	2	-	60
24	-	-	-	-	11	21	20	21	7	2	82
25	-	-	-	-	3	8	26	17	10	3	67
26	-	-	-	-	3	18	40	40	26	9	136
27	-	-	-	-	2	11	19	40	40	13	125
28	-	-	-	-	1	16	74	125	107	60	383
Total	171	197	231	263	270	262	299	267	195	88	2237
					GIRLS						
0	11	3									14
1	6	2									8
2	15	3									18
3	13	1									14
4	15	5									20
5	8	6									14
6	38	26	6								70
7	7	12	1								20
8	17	25	14	-	1						57
9	6	20	8	-	-						34
10	15	51	46	4	4	1					121
11	1	15	25	3	2	-					46
12	2	28	89	60	21	3	1				204
13	1	4	30	36	16	3	2				92
14	-	2	15	24	12	7	1	1			62
15	-	2	10	31	24	6	1	-			74
16	-	-	6	15	23	6	4	1			55
17	-	-	2	13	14	7	2	-			38
18	-	-	2	19	23	12	7	2			65
19	-	-	-	11	16	15	4	1			47
20	-	-	1	8	22	11	15	3			60
21	-	-	1	4	12	18	8	2	1		46
22	-	-	-	3	12	26	16	6	-		63
23	-	-	-	6	13	12	10	6	2		50
24	-	-	-	2	18	35	17	14	3	1	90
25	-	-	-	1	7	30	18	16	6	2	80
26	-	-	-	-	8	23	47	32	5	6	125
27	-	-	-	-	2	15	29	39	22	8	115
28	-	-	-	-	9	39	113	156	122	41	480
Total	155	206	286	240	269	269	297	278	165	58	2102

TABLE 2

NUMBER OF LOWER FIRST PERMANENT MOLARS ERUPTED IN THE MOUTHS OF CHILDREN HAVING SPECIFIED TOTAL NUMBERS OF PERMANENT TEETH ERUPTED.
DATA DERIVED FROM DENTAL EXAMINATIONS OF ELEMENTARY SCHOOL CHILDREN, HAGERSTOWN, MARYLAND

Total number of permanent teeth erupted	AGE (Years last birthday)										All Ages
	6	7	8	9	10	11	12	13	14	15	
BOYS											
0	-										
1	6										6
2	20	-	2								22
3	17	6	1								24
4	40	16	-								56
5	21	11	-								32
6	60	86	6	2							166
7	14	36	20	2							72
8	16	34	42	10							102
9	4	24	20	8	2						58
10	16	78	116	38	4						252
11	4	24	60	26	14	2					130
12	6	42	104	156	84	14	4	2			412
13	-	2	58	68	60	22	6	-			216
14	-	2	24	58	42	12	14	2			154
15	-	2	4	58	68	30	8	2			172
16	-	-	6	30	42	34	10	2			124
17	-	-	-	10	36	36	12	2			96
18	-	-	-	20	32	36	18	2			108
19	-	-	-	8	32	17	26	6	2		91
20	-	-	2	4	28	54	26	2	-		116
21	-	-	-	-	12	26	16	12	6	2	74
22	-	-	-	4	20	66	48	10	6	-	150
23	-	-	-	4	18	36	52	6	4	-	120
24	-	-	-	-	22	41	40	42	14	4	163
25	-	-	-	-	6	16	52	33	20	6	133
26	-	-	-	-	6	38	80	80	51	16	271
27	-	-	-	-	4	22	37	80	79	26	248
28	-	-	-	-	2	32	148	250	214	120	766
Total	224	362	457	506	540	522	597	633	396	178	4013
GIRLS											
0											
1	2										2
2	10	2									12
3	16	1									17
4	26	5									31
5	14	11									25
6	76	50	12								138
7	14	22	2								38
8	34	50	28	-	2						114
9	11	40	14	-	-						65
10	30	101	92	8	8	2					241
11	2	30	50	6	4	-					92
12	4	56	178	120	42	6	2				408
13	2	8	60	72	32	6	4				184
14	-	4	30	48	24	14	2	2			124
15	-	4	20	62	48	12	2	-			148
16	-	-	12	30	46	12	8	2			110
17	-	-	4	26	28	14	4	-			76
18	-	-	4	38	46	24	14	4			130
19	-	-	-	22	32	30	8	2			94
20	-	-	2	16	44	22	30	6			120
21	-	-	2	8	24	36	16	4	2		92
22	-	-	-	6	24	51	32	12	-		125
23	-	-	-	12	26	23	24	10	4		99
24	-	-	-	4	36	70	34	28	6	2	180
25	-	-	-	2	14	60	36	32	12	4	160
26	-	-	-	-	16	46	94	64	18	12	250
27	-	-	-	-	4	30	58	78	44	16	230
28	-	-	-	-	18	78	226	312	244	82	960
Total	241	384	510	480	518	536	594	658	330	116	4265

TABLE 3

NUMBER OF LOWER FIRST PERMANENT MOLARS DECAYED, MISSING OR FILLED (DMF) IN THE MOUTHS OF CHILDREN HAVING SPECIFIED TOTAL NUMBERS OF PERMANENT TEETH ERUPTED. DATA DERIVED FROM DENTAL EXAMINATIONS OF ELEMENTARY SCHOOL CHILDREN, HAGERSTOWN, MARYLAND

Total number of permanent teeth erupted	AGE (Years last birthday)										
	6	7	8	9	10	11	12	13	14	15	All Ages
				BOYS							
0											
1	2										2
2	-										-
3	1										1
4	2										2
5	-										-
6	6	15	3								24
7	2	3	4								9
8	6	5	6	1							18
9	-	9	3	4							16
10	4	20	26	18							68
11	4	4	17	6	6						37
12	-	16	39	58	37	8					158
13	-	-	28	41	28	14	4				115
14	-	2	14	31	28	5	7				87
15	-	2	4	33	37	11	2				89
16	-	-	4	20	25	21	8	2			80
17	-	-	-	6	25	24	9	1			65
18	-	-	-	15	23	20	9	-			67
19	-	-	-	3	19	7	15	4	1		49
20	-	-	2	2	14	39	21	-	-		78
21	-	-	-	-	10	14	8	9	4	2	47
22	-	-	-	4	20	37	32	7	3	-	103
23	-	-	-	4	12	28	43	2	4	-	93
24	-	-	-	-	18	27	29	32	11	4	121
25	-	-	-	-	4	12	26	25	19	5	91
26	-	-	-	-	4	31	53	59	36	17	200
27	-	-	-	-	-	11	31	62	66	26	196
28	-	-	-	-	1	21	109	159	153	105	548
Total	27	76	150	246	311	330	406	362	297	159	2364
				GIRLS							
0											
1	1										1
2	1	1									2
3	1	-									1
4	2	-									2
5	-	-									-
6	9	9	3								21
7	3	8	1								12
8	8	12	5	-	2						27
9	-	14	5	-	-						19
10	12	43	26	3	5						89
11	-	8	22	2	1						33
12	-	19	62	43	22						146
13	-	4	35	42	21	3	3				108
14	-	4	17	25	14	4	1	1			66
15	-	3	15	37	29	6	2	-			92
16	-	-	6	17	15	8	4	2			52
17	-	-	2	23	20	13	2	-			60
18	-	-	3	32	33	18	7	3			96
19	-	-	-	16	23	14	4	2			59
20	-	-	-	13	31	12	19	5			80
21	-	-	2	7	20	25	13	3	1		71
22	-	-	-	1	18	36	25	9	-		89
23	-	-	-	9	20	19	19	6	4		77
24	-	-	-	2	25	45	19	26	3	2	122
25	-	-	-	2	10	34	23	21	10	4	104
26	-	-	-	-	12	29	69	53	18	11	192
27	-	-	-	-	4	23	46	68	39	14	194
28	-	-	-	-	16	53	154	257	201	69	750
Total	37	125	204	274	341	342	410	456	276	100	2665

quartile" contain, therefore, data for that 25 per cent of the children in each age-sex group who have the fewest number of erupted teeth; the "second quartile" contains data for the next 25 per cent of the children who have the next fewest number of erupted teeth; the "third quartile" contains data for the next 25 per cent; the "fourth quartile" contains data for the remaining children, or those who have the highest number of erupted permanent teeth. This method of classification of the children according to number of erupted permanent teeth provides, on the basis of the hypotheses discussed in a previous section of this paper, four groups of children that are assumed to be differentiated with respect to the earliness or lateness of the time of eruption of their permanent teeth. Thus the first quartile contains the children who may be considered to be the "latest" eruptors; the fourth quartile, children who may be classed as the "earliest" eruptors; the second and third quartiles represent children intermediate between these two extremes in the time of eruption of their teeth.

The arrangement of the data given in Tables 2 and 3, according to quartile subdivisions of the distributions given in Table 1, provides material for tabulations of the number of erupted lower first molars and the number of these teeth attacked by caries for children in each quartile group.

TABLE 4

PER CENT OF ERUPTED FIRST LOWER MOLARS THAT HAVE BEEN ATTACKED BY CARIES (DMF), BY QUARTILES OF DISTRIBUTION OF CHILDREN ARRANGED ACCORDING TO TOTAL NUMBER OF PERMANENT TEETH ERUPTED. DATA DERIVED FROM DENTAL EXAMINATIONS OF ELEMENTARY SCHOOL CHILDREN, HAGERSTOWN, MARYLAND

	AGE (Years Last Birthday)									
Quartile	6	7	8	9	10	11	12	13	14	15
					BOYS					
First	12.0	9.0	18.0	34.8	42.6	53.7	59.8	67.2	76.0	95.5
Second	4.4	14.0	24.1	39.2	56.6	62.2	71.6	75.5	81.1	90.9
Third	6.0	26.0	36.5	56.8	64.9	67.2	66.9	65.3	71.5	87.5
Fourth	21.8	31.3	52.0	83.6	66.3	69.8	73.8	83.6	*	*
					GIRLS					
First	12.4	17.3	26.8	35.8	58.4	55.0	67.6	78.2	87.2	91.8
Second	7.1	29.8	37.3	53.9	55.1	70.8	67.4	85.2	82.7	84.7
Third	14.6	42.4	35.9	61.4	73.7	80.7	73.0	82.4	82.4	84.2
Fourth	24.1	37.6	59.8	77.2	76.2	68.9	88.1	*	*	*

* Separate quartile values not obtainable because 50 percent or more of the children have the full complement of 28 permanent teeth erupted.

From these tabulations the percentages of lower first molars that are decayed, missing or filled (DMF) are calculated. These are shown in Table 4. Inspection of this table makes evident the fact that marked and consistent respective differences exist in the caries experience of children of the several quartile subdivisions. For example, at eight years of age, boys who may be designated as the earliest eruptors (those in the fourth quartile at this age) have 31.3 per cent of their lower first molars attacked by caries, while boys at the same age who may be designated as the latest eruptors (those in the first quartile) have only 9 per cent of their lower first molars DMF. Caries attack rates intermediate between these are found for boys in the second and third quartile. Except for children in the older age groups, where the method of differentiation based on the number of erupted teeth does not allow a precise separation of the quartile groups,[7] the differences between the various quartile categories clearly show that the earlier the teeth erupt the higher is the percentage of lower first molars attacked by caries. In order to illustrate these differences, Figure 1 shows graphically the relation between the caries attack rates and chronological age for the boys in the first and fourth quartile groups. In general, in both sexes, it is apparent that the earliest eruptors show very much higher caries attack rates than do the latest eruptors for that period during which it is possible to distinguish, with reasonable precision by the method adopted, between the early and late eruptors.

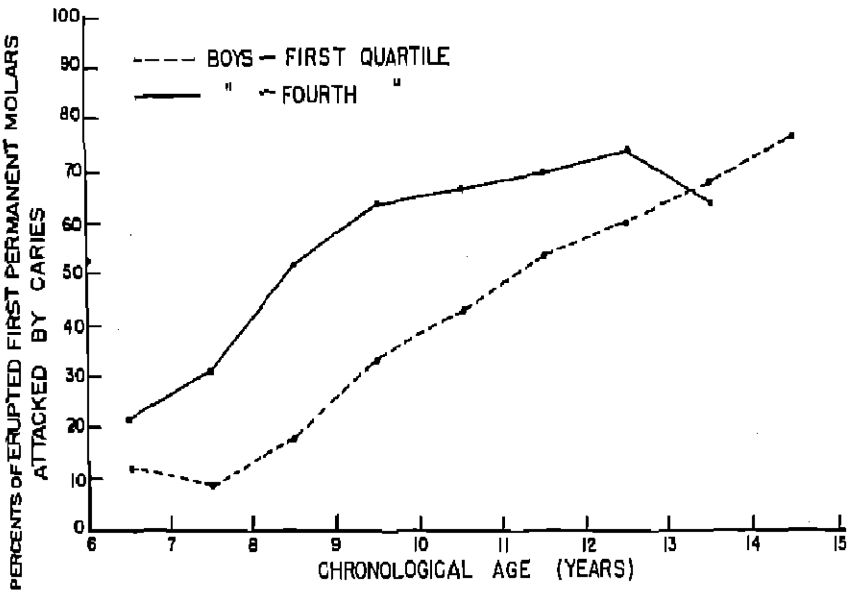

Fig. 1. The relationship between chronological age and the per cent of the lower first permanent molars that are attacked by caries (DMF). For boys who are designated "earliest" and "latest" eruptors. See text for a description of the latter terms.

In the preliminary discussion of methodology applicable to the problem under consideration in this paper, it was pointed out that the length of time the teeth are exposed to the environment of the mouth bears a very significant relation to attack of the teeth by caries. Moreover, it was noted that at the same chronological age the teeth of relatively early eruptors will be exposed in the mouth longer than will the teeth of late eruptors. The immediate consequence of these two factors naturally may be postulated to find expression in a higher caries rate for early as contrasted with late eruptors and, indeed, this is the result observed in Table 4 and Figure 1. In order to determine whether or not early or late eruption, per se, is related to caries experience it becomes necessary, as has been pointed out, to control or equalize the factor of mouth exposure. Exploration of this subject leads directly to the practical application of a technique for estimating post-eruptive tooth age which has been described in a previous paper (8). Use of this technique in the special problem under discussion here requires a slight elaboration of the original concept of post-eruptive tooth age.

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[7] As pointed out earlier in this paper, the determination of relative time of eruption of the teeth from counts of total number of erupted teeth cannot be determined by this method when the total count of teeth approaches the complement of 28 teeth. In boys this point is reached for the third and fourth quartiles in the 13-year old group and in girls it is reached for these quartiles in the 12-year old group.

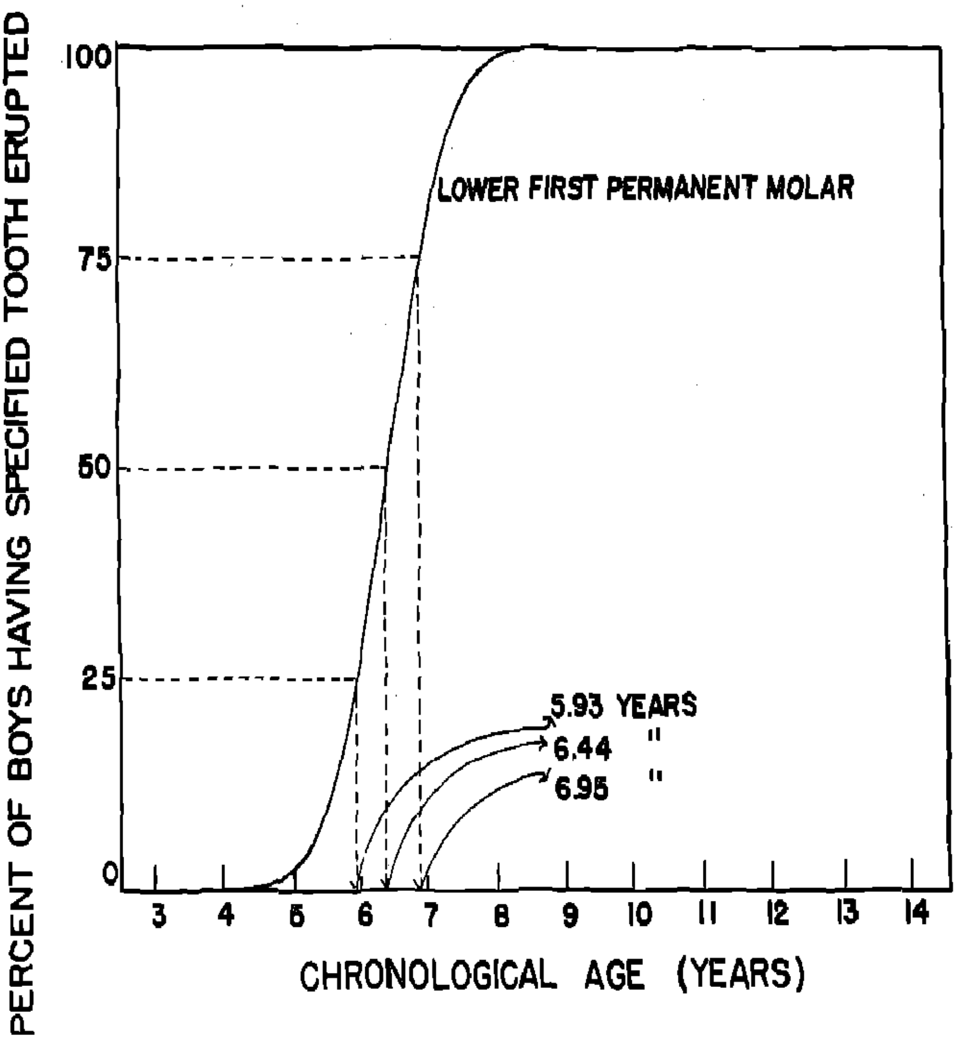

Fig. 2. The relationship between chronological age and the per cent of boys having the lower first permanent molar tooth erupted into the mouth.

It has been shown that the age distribution of eruption of a single morphological type of tooth, say the lower first permanent molar in boys, may be described mathematically by the normal probability (Gaussian) curve (7). In addition, it has been shown that the integral of this curve furnishes a very useful mathematical description of the eruption of a particular tooth into the mouths of a group of children. Figure 2 shows graphically this relationship between chronological age and the appearance of the lower first permanent molar[8] in boys. On this graph, the S-shaped curve[9] describes the increase with age in the per cent of boys who have the lower first molar erupted into the mouth. Thus the graph illustrates the fact that in 25 per cent of the boys this tooth has appeared by the age of 5.93 years, in 50 per cent it has appeared by the age of 6.44 years, and in 75 per cent by the age of 6.95 years.

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[8] Since it has been shown (7) that no statistically significant differences exist in the time of eruption of corresponding teeth on the right and left side of the same jaw, a single curve may be used to describe the age distribution of eruption of either tooth.

[9] The mean and standard deviation of the normal curve which describes the age distribution of eruption of the lower first permanent molar in boys are, respectively, 6.44 years and 0.75 years. Analogous figures for this tooth in girls are 6.12 and 0.67 years. (See reference 7)

Since the ordinal scale for the graph given in Figure 2, although entitled per cent of children having the tooth erupted, also represents number of teeth, and since the abscissal scale, although entitled chronological age, also represents age in years, it may be noted that the product of these two axes, or the area in the coordinate system, represents tooth years. From the biological or epidemiological standpoint, tooth years furnish a precise measure of years of exposure of the teeth in the mouth. Through the application of the technique of the integral calculus it becomes clear that the area under the S-shaped curve up to any specified chronological age, or the double integral of the normal curve from minus infinity ($-\infty$) to the specified age, represents this measure of the number of tooth years of mouth exposure of the lower first molar tooth. Furthermore, the subdivision of the area under the S-shaped curve into parts, as illustrated in Figure 3, furnishes a simple method for obtaining tooth years of exposure of the teeth for quartile groups, or for any other desired subdivision,

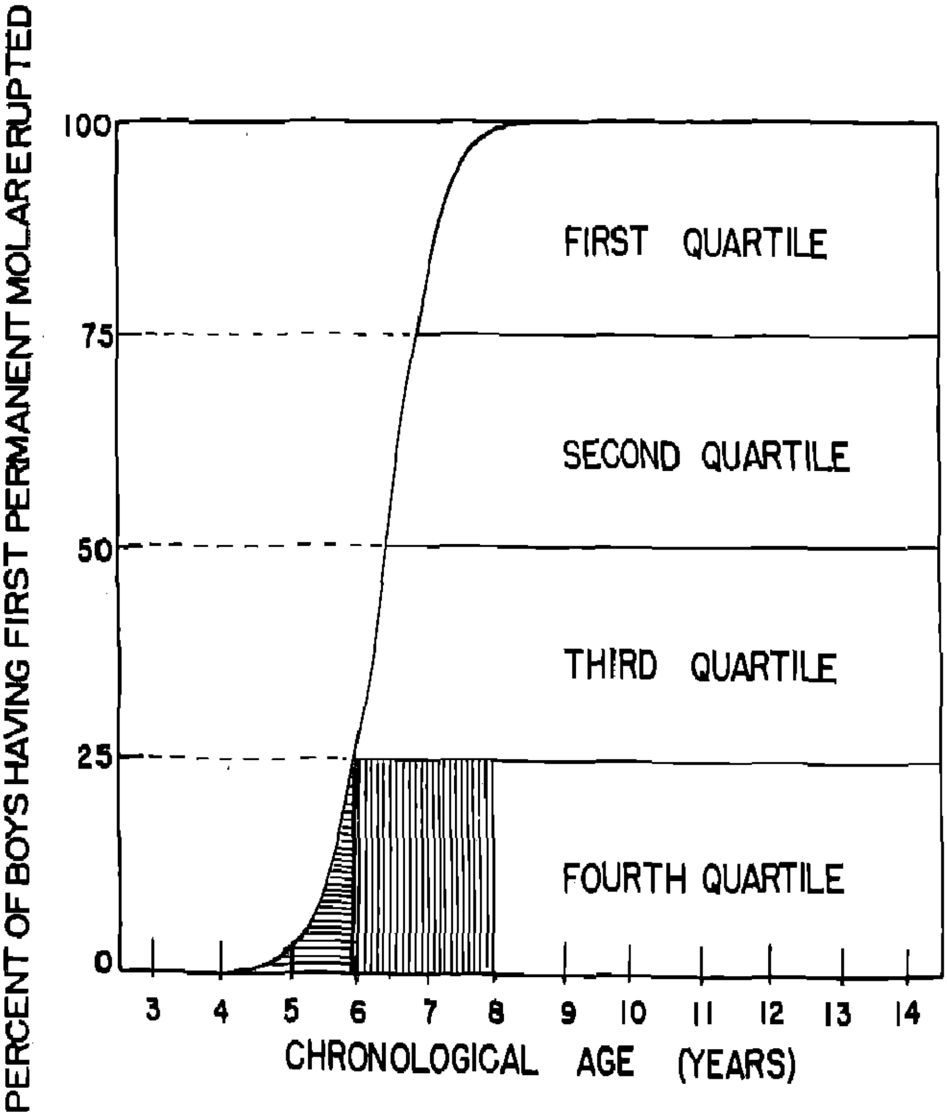

Fig. 3. Diagramatic illustration of the method of calculating post-eruptive tooth years of exposure in the mouth of the lower first permanent molar tooth of boys. See text for description.

ution of children according to the time of eruption of the particular
kample of the actual calculation of the tooth years of exposure of
tooth in the mouths of a special group of boys may facilitate the
this methodology.

It is desired to determine the tooth years of exposure of the lower
rmanent molar in a group of exactly 8-year old boys who repre-
per cent of the total group of boys who first have this tooth
e mouth (designated fourth quartile group in Figure 3). In terms
al calculus, and as illustrated in Figure 3, the tooth years of ex-
s special group of boys is represented by the shaded area under the S-
which is bounded as follows: a) the horizontal abscissal line in
b) a vertical line through the point on the abscissa which marks
l age of eight years; c) a horizontal line through the point of
which is marked 25 per cent, and d) the portion of the S-shaped
lies between the intersection of this curve with the two horizontal
s. The actual determination of the area so marked out may be
in two steps; first, the measurement of the irregularly shaped
shaded with horizontal lines and, second, the measurement of the
rea which is shaded by vertical lines. The horizontally shaded
he curve may be represented by the double integral of the normal
∞ *to the point on the scale of chronological age where 25 per cent*
ave the tooth erupted. Since the mean and standard deviation of
urve representing the age distribution of eruption of the lower first
olar in boys has been shown (7) to equal 6.44 and 0.75 years,
the latter point may be shown readily to equal 5.93 years.[10]
les of the double integral of the normal curve given in reference
be determined that this portion of the total area, or time of ex-
teeth up to age 5.93 years equals 0.45 tooth years.[11] The rec-
tion of the area (shaded with vertical lines) representing exposure
from 5.93 years to 8.0 years, is equivalent by simple subtraction
years. The sum of the two subdivisions of the total area ob-
s 2.52 years. This last figure, 2.52 years, represents the average
e of exposure of the lower right first permanent molar in the
ys eight years of age who represent the first 25 per 100 boys to

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l calculation of this value may be accomplished as follows: from Pearson's
isticians and Biometricians, (Second Edition, 1924, page 2) it may be found
al of the normal curve is 0.25 for the argument

$$\frac{x-m_x}{\sigma_x} \text{ equals } -0.67449, \text{ where } m_x \text{ is the mean and } \sigma_x$$

deviation of the normal curve. Since the particular normal curve under dis-
mean at 6.44 years and its standard deviation equal to 0.75 years, solution of

$$-0.67449 = \frac{x-6.44 \text{ years}}{0.75 \text{ years}}$$

uals 5.93 years. Thus, the chronological age of 5.93 years represents the age
cent of the boys have the lower right first molar erupted into the mouth.

l calculation of this value may be accomplished as follows:

table of the double integral of the normal curve given in reference (6) it read-
rmined by simple interpolation that

$$\int_{-\infty}^{-0.67449}\int_{-\infty}^{-0.67449}\frac{1}{\sqrt{2\pi}}\,e^{-\frac{1}{2}x^2}\,dx\,dx = 0.1492$$

.1492, which is the value of the double integral in terms of a standard deviation
, is transformed into years of exposure by multiplying this value by 0.75 (the
tion of the normal curve under discussion). In order to furnish a more easily
pression of tooth years of exposure for the children in a single quartile group,
xposure given directly above may be multiplied by four. Thus, 0.1492 times 0.75
(approximately) 0.45 years.

have this tooth appear in the mouth. Obviously, the exposure of the two lower first molars in the mouths of these boys is double this value or 5.04 years. Calculations similar to those given for this particular example may be made to furnish analogous figures for the years of exposure in the mouths of other subdivisions of the distribution of the time of eruption of these and other teeth. The technique described here provides very useful data for the problem under discussion in this paper.

The third successive step in the study of the relationship between caries experience and the time of eruption of the teeth consists, through the use of the procedure which has been illustrated above, of the determination of the tooth years of exposure for each of the quartile subdivisions of each age-sex group of children. The results of this work are shown in Table 5, and at this point it is necessary to discuss an important assumption which is made in connection with the derivation and use of the figures given in this table.

TABLE 5

AVERAGE POST-ERUPTIVE TOOTH AGE, YEARS OF EXPOSURE IN THE MOUTH, OF THE LOWER FIRST PERMANENT MOLAR TEETH; BY QUARTILES OF DISTRIBUTIONS OF CHILDREN ARRANGED ACCORDING TO TOTAL NUMBER OF PERMANENT TEETH ERUPTED. DATA DERIVED FROM DENTAL EXAMINATIONS OF 4,416 ELEMENTARY SCHOOL CHILDREN, HAGERSTOWN, MARYLAND

	AGE									
Quartile	6.5	7.5	8.5	9.5	10.5	11.5	12.5	13.5	14.5	15.5
	BOYS									
First	*	0.43	2.22	4.21	6.21	8.21	10.21	12.21	14.21	16.21
Second	0.01	1.63	3.63	5.63	7.63	9.63	11.63	13.63	15.63	17.63
Third	0.61	2.61	4.61	6.61	8.61	10.61	12.61	14.61	16.61	18.61
Fourth	2.03	4.03	6.03	8.03	10.03	12.03	14.03	16.03	18.03	20.03
	GIRLS									
First	*	0.72	2.56	4.56	6.56	8.56	10.56	12.56	14.56	16.56
Second	0.26	2.20	4.20	6.20	8.20	10.20	12.20	14.20	16.20	18.20
Third	1.32	3.32	5.32	7.32	9.32	11.32	13.32	15.32	17.32	19.32
Fourth	2.97	4.97	6.97	8.97	10.97	12.97	14.97	16.97	18.97	20.97

* According to the theoretical development on which this table is based, no lower molar teeth are erupted by the age of 6.5 years in the mouths of children in the first quartile

Briefly, this consists of the assumption that the measure of the relative time of eruption of all of the permanent teeth, that is, counts of the total number of erupted teeth, is precisely correlated with the time of eruption of a single morphological type of tooth, the lower first molar. Thus it is assumed that the 25 per cent of the children who have the fewest number of erupted teeth actually represent the 25 per cent of the children who are last to have the lower first molar appear in the mouth. Similarily, the 25 per cent of the children who have the largest number of erupted teeth are assumed to be that 25 per cent of the total group who were the first to have the lower first molar erupt. Observational data with which to justify this assumption are not available but it seems reasonable to believe that this broad grouping of the children into quartile classes on the basis of total number of erupted teeth also serves to group the children into broad and fairly well differentiated classes with respect to the relative time of eruption of the lower first molar.

Careful consideration of the method used in the derivation of post-eruptive tooth ages, as given in Table 5, will reveal the fact that the years of mouth exposure which are recorded represent averages for children at an exact chronological age. For example, the figure of 4.02 years given in Table 5 for the post-eruptive tooth age of boys in the fourth quartile who have a chronological age of 7.6 years, represents the average length of time the lower first permanent molar teeth are exposed in the mouth when these boys are exactly 7.5 years of age. Similar consideration of the data given in Table 4 will reveal the fact that the percentages of first molar teeth attacked by caries represent averages for groups of children whose chronological ages range over a one year span which only centers at an exact chronological age. For example, the figure of 31.3 per cent given in Table 4, as the per cent of lower first molars attacked by caries for boys in the fourth quartile who were recorded as seven years of age on their last birthday, represented an average of 7.5 years for boys whose actual ages range from seven to eight years. From this discussion it is apparent that the values of 4.02 years and 31.3 per cent, which apply in the above example, constitute somewhat different types of averages. The former represents a simple mean of the lengths of time the teeth of the particular group of children are exposed in the mouth; the latter represents an average with respect to the two variables, teeth and chronological age. While both types of averages, such as are illustrated by the figures 4.02 and 31.3, are very frequently obtained in practical statistical work, it has seemed desirable to bring out the point that a distinction does exist between them. In particular it appears pertinent to stress this distinction since the final results of the study will be expressed in terms of a direct comparison of these two types of averages. Thus it seems justifiable to state that, after an average exposure of 4.02 years in the mouth, an average of 31.3 per cent of the lower first molars of boys in the fourth quartile has been attacked by caries. In a similar way, after an average exposure of 6.02 years, boys of the fourth quartile class show 52.0 per cent of their lower first molars attacked by caries.

RESULTS

Acceptance of the data given in Table 5 as satisfactory measurements of the time of exposure in the mouth of the lower first molar teeth specific for the several quartile groups of children and of the data given in Table 4 as satisfactory measurements of caries experience, permits a full comparison of these two variables. Figures 4 and 5 show, therefore, the results of graphic presentations of the relationship between caries experience and post-eruptive tooth age for the four groups of boys and girls who are differentiated with respect to the relative time of eruption of the teeth. In these graphs the abscissae show average post-eruptive tooth age and the ordinates show the per cent of lower first permanent molars attacked by caries. The data shown on the graphs represent the results of plotting corresponding values of tooth age and per cent of teeth DMF as shown in Tables 4 and 5, and separate lines show the relationship between these two variables for the four quartile groups of children. Careful study of these graphs indicates that rather slight differences appear to exist between the several quartile groups of children when comparisons in attack of the teeth by caries are made in terms of the length of time the teeth are exposed to the environment of the mouth. Thus it is clear that caries attack rates are very similar for the first part of the range of post-eruptive tooth age. In the central part of the range over which comparisons are made, however, it is evident that children in both

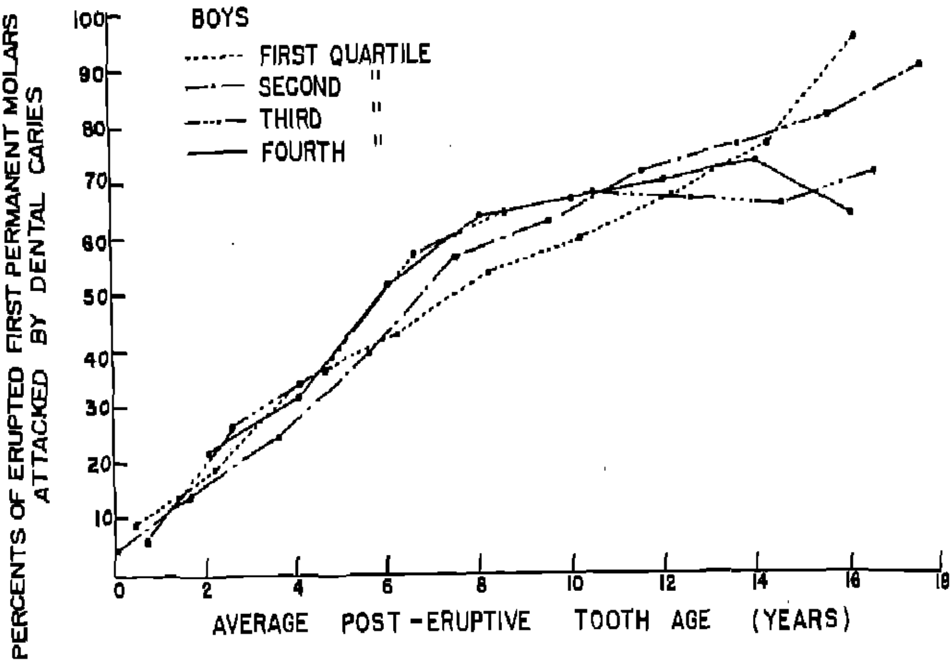

Fig. 4. The relationship between post-eruptive tooth age and per cent of lower first permanent molars attacked by caries. Four quartile groups of children differentiated with respect to time of eruption of the teeth. Boys.

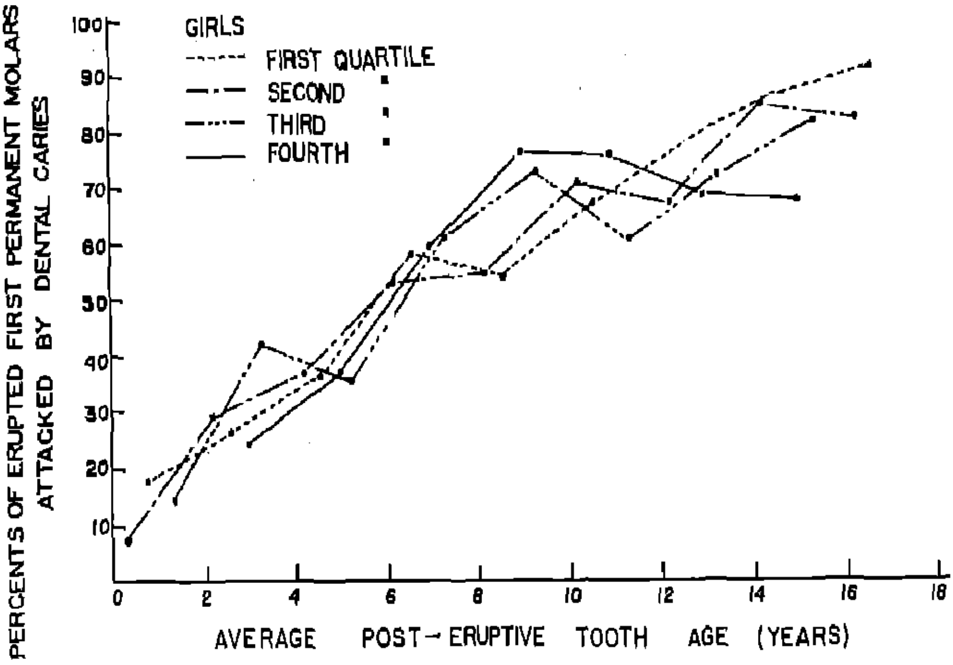

Fig. 5. The relationship between post-eruptive tooth age and per cent of lower first permanent molars attacked by caries. Four quartile groups of children differentiated with respect to time of eruption of the teeth. Girls.

the third and fourth quartiles appear to have slightly higher caries attack rates than children in the first and second quartiles whose teeth have had an equivalent period of exposure in the mouth. A test for the statistical significance of the differences between the quartile groups presents a rather difficult problem and will not be attempted here in terms of rigorous statistical methodology. However, the maximum difference which exists between the individual quartile groups is of the order of 15 per cent. In order that such a difference be statistically significant (twice the standard error of the difference), it may be shown that the two groups being compared would need to contain of the order of 90 cases each. Since none of the quartile groups contains as many children as this, it becomes evident, on the basis of the present approximations, that none of the differences between these groups individually can be considered statistically significant.[12]

The findings presented in this paper clearly indicate that children who erupt their permanent teeth early may be expected to have at comparable chronological ages higher levels of caries experience than children who are late eruptors. These marked differences in caries experience, however, are explained by the fact that the *teeth of early eruptors have been exposed to the risk of caries for longer periods of time than the teeth of late eruptors.* The analysis would appear to demonstrate that, per year of mouth exposure (tooth age), early eruptors show no significant differences from late eruptors in their caries attack rates. Taking all the findings together, and especially those derived from the comparison of the quartile groups over the first part of the range of post-eruptive tooth age, it may be concluded that the present study furnishes no significant evidence to indicate that the time of eruption, *per se*, influences caries attack rates of the lower first permanent molars.

SUMMARY AND CONCLUSION

The study presents a statistical analysis of the relationship between the time of eruption of the lower first permanent molars and attack of these teeth by caries. Data for the analysis are derived from a dental survey of approximately 4,400 elementary school children of Hagerstown, Maryland. Results of the study show that children who erupt their permanent teeth early have at comparable chronological ages higher absolute levels of caries experience than do children who erupt their permanent teeth late. The analysis of these differences in caries experience in terms of respective differences in the tooth years of mouth exposure leads to the conclusion that little relationship appears to exist between time of eruption, *per se*, and attack of the lower first permanent molar, by caries.

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[12] Study of the data given in Figures 4 and 5 at the middle part of the range of post-eruptive tooth age suggests that early eruption may intensify attack by caries in the molar teeth. The analysis of the statistical significance of this selected section of the experience is under study at the present time.

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STUDY OF THE CHARACTERISTICS OF 250 JUNIOR HIGH SCHOOL CHILDREN[1]

J. ALLAN HICKS AND MARGARET HAYES[2]

INTRODUCTION

This is a report of an investigation of the personality development of a group of 250 junior high school children. By means of interviews, controlled observations, objective tests, ratings, and other data obtained by the school, a fairly comprehensive picture of the development of this group was obtained.

The general purpose of this study was to obtain a comprehensive picture of a group of developing adolescents. A more specific purpose was to compare the development of the best adjusted and intellectually promising children, with the development of the other children in their classes. It was hoped that differences might be discovered which could be looked for as clues in locating potential leaders. Finally, all information was to be utilized in developing the guidance program of the school, so that the educational, vocational, and personal needs of children might be met more adequately.

The 250 children included in this study attended the Milne High School, Albany, New York. The Milne School is the practice school for the New York State College for Teachers and annually enrolls approximately 400 students distributed about equally in the six grades, 7 to 12 inclusive. This school has well developed junior and senior high school programs. The teaching is done largely by senior college students under expert supervision.

GROUPS STUDIED

All of the junior high school children were divided into four groups hereafter designated as leadership groups. Table 1 indicates the number of boys and girls in each of the four leadership groups for each of the one year age groups and for age and sex groups combined. It should be noted in interpreting the data in this study that the method of selection for placement in groups resulted in placing an excessive number of girls in groups 1 and 2.

The four leadership groups were determined by combining each child's ranking in his class on an intelligence quotient, an achievement quotient, and a personality rating. Table 2 gives the medians for these measures for each of the four groups. Group 1 is approximately the one quarter of the pupils ranking highest on the combined three measures; group 2 is the next one fourth of the children on the basis of this ranking; group 3 the next one fourth, and group 4 the last one fourth. The intelligence quotients were computed from scores on the Otis Self-administering Tests of Mental Ability, Intermediate Examination; the achievement quotients from total scores on the Stanford Achievement Tests; and the personality ratings from ratings of pupils by home room teachers on an adaptation of the personality report, revision B, of the American Council on Education.

On the personality rating the following five questions were marked for each pupil on a five point scale:

1. How are you and others affected by his appearance and manners?
2. Does he need constant prodding or does he go ahead without being told?

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3. Does he work well with a group?
4. Does he get others to do what he wishes?
5. Is he able to do creative work?

A personality score was obtained by scoring each trait from one to five according to the rating on the trait. The maximum score obtainable was 25 and the minimum 5.

TABLE 1

CHILDREN IN STUDY OF ADOLESCENT PERSONALITY, BY LEADERSHIP, AGE, AND SEX GROUPS

Leadership Group	Age						All Ages
	11	12	13	14	15	16	
			Girls				
1	8	8	9	9	5	3	42
2	4	8	13	6	9	5	45
3	3	5	8	6	11	4	37
4	3	4	7	3	2	5	24
All	18	25	37	24	27	17	148
			Boys				
1	5	3	5	5	2	1	21
2	2	6	3	1	4	2	18
3	3	5	7	4	2	6	27
4	2	4	7	6	10	7	36
All	12	18	22	16	18	16	102
			Boys and Girls				
1	13	11	14	14	7	4	63
2	6	14	16	7	13	7	63
3	6	10	15	10	13	10	64
4	5	8	14	9	12	12	60
All	30	43	59	40	45	33	250

TABLE 2

INTELLIGENCE QUOTIENTS, EDUCATIONAL QUOTIENTS, AND PERSONALITY SCORES OF PUPIL LEADERSHIP GROUPS

Leadership Groups	Number	Intelligence Quotients		Educational Quotients		Personality Scores	
		Median	Q	Median	Q	Median	Q
1	63	125		132		20	
2	63	117		118		17	
3	64	113		103		16	
4	60	107		98		12	
Total	250	115	5.6	114	11.5	16	3

An analysis of the occupations of the fathers of the children in this study revealed that 20 per cent were in occupations listed in Group I of the United States Census classification, 55 per cent were in Group II, 10 per cent in Grou III, and 15 per cent were retired, divorced or dead. Of the mothers 87 per cent were housewives, 8 per cent were dead or divorced, and 5 per cent were employed.

Of the 250 children included in the study, 24 per cent were only children, 36 per cent had one sib, 20 per cent had two, 12 per cent had three, 5 per cent had four, and 2 per cent had five. The average number of children per family was 2.4.

In 64 per cent of the families no adults other than the parents were living in the home. In 29 per cent a relative, most often a grandmother, lived with the family. Thirteen per cent of the families had servants living in the home and 9 per cent had paying roomers.

There were no significant differences relative to occupations of parents, numbers of children, or other adults living in the home between the four groups of children.

Throughout this study data are generally given for leadership groups 1 and 4 separately and combined, and for sex groups, separately and combined. In some cases data are also given for groups 2 and 3.

THE DATA

The data obtained will first be briefly described and then analyzed under each of the following headings:

1. Standardized test results.
    a. Intelligence quotients obtained from the Otis Self-administering Tests of Mental Ability, Intermediate Examination.
    b. Achievement quotients obtained from the Stanford Achievement Tests.
        (1) Total Arithmetic quotient.
        (2) Arithmetic computation quotient.
        (3) Arithmetic reasoning quotient.
    c. Reading quotient from Thorndike-McCall Tests.
2. Interviews.

The 123 children in groups 1 and 4 were given a standardized interview in order to obtain more reliable information regarding the interests, desires, and activities of the children than could be obtained by questionnaires. The interviewer conducted these interviews in an informal manner and obtained excellent cooperation. Very few notes were taken during the interview, but data were recorded immediately after the conclusion of the interview.

3. Personality ratings.

All children were rated by their teachers on the Hayes, "Scale for Evaluating the School Behavior of Children, Ten to Fifteen."[3] This scale consists of 100 behavior items which are grouped under the headings: (a) relations to others generally, (b) respect for rights of others, (c) relations to teachers, (d) relations to other pupils, (e) initiative, (f) health habits, (g) general interests, (h) scholarship and study habits. The test manual gives score values for each item on the scale and percentile norms for the whole scale and for each of the eight sub groups.

4. Health data.

All children were given a physical examination and a general health rating was assigned. The highest rating was A and the lowest E. In addition various physical defects were listed.

5. Observations of verbal responses in classroom discussions.[4]

A code system was devised for recording pupil responses on a seating chart. All pupils in a class were observed simultaneously by the observer for units of 20 minutes. Classes observed were English, Social Science, Mathematics, and General Science. The average size of the classes was 20 pupils and the range 11 to 27. Each student was observed twice in each class so that there were 8 observations for each of the 250 children, and a total of 2000, 20-minute observations. The average number of responses for 20 minutes for each of the types of response recorded was computed for the four leadership groups. For purposes of analysis the responses were grouped under three heads: (1) responses indicating command of subject matter, (2) responses indicating desirable aggressiveness, and (3) responses indicating undesirable aggressiveness.

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[4] For description of this technique see, Hicks, J. A., and Hayes, M. L., "The verbal responses of junior high school pupils in classroom discussions." Child Development, 1933, 4, 176-182.

6. Subject matter grades.

The percentage grades given by teachers in the various subjects are analyzed for leadership groups and for sex groups.

7. Progress through the grades.

The number of grades skipped or repeated is compared for leadership groups.

STANDARDIZED TESTS

Table 3 gives the medians and quartile deviations for intelligence, reading, and arithmetic quotients for leadership and sex groups. Table 3 shows that the median intelligence quotient for boys and girls combined is 125 for leadership group 1, 117 for group 2, 113 for group 3, 107 for group 4, and 115 for all groups combined. There are no pupils with an I.Q. below 90. Thus all of the children are average or above in intelligence, as measured by tests. The quartile deviations are relatively small, indicating that the variability in I.Q's is not great. It is evident that the children studied are above the level of intelligence found in most public high schools. Even leadership group 4 has a median I.Q. of 107. These facts should be borne in mind in interpreting the data of this study. There are marked differences in the measures on the four leadership groups but the differences are relative. In so far as a picture of the nature and needs of the whole group of children studied is given, it is a picture of children of average or above average in intelligence as measured by tests.

TABLE 3

INTELLIGENCE, READING, AND TOTAL ARITHMETIC QUOTIENTS, FOR LEADERSHIP AND SEX GROUPS

Leadership Group	Intelligence Quotients		Reading Quotients		Arithmetic Quotients	
	Median	Q	Median	Q	Median	Q
Girls						
1	124	3.9	131	5.5	133	6.6
2	116	3.3	117	6.4	120	10.5
3	113	2.9	110	8.0	111	7.3
4	110	4.7	101	5.3	104	8.8
Total	116	5.3	116	11.0	121	11.2
Boys						
1	128	3.4	132	5.4	138	8.1
2	118	3.4	117	6.4	115	14.4
3	113	3.2	108	11.0	116	5.0
4	105	4.4	94	14.7	108	9.2
Total	114	6.6	114	14.7	116	10.6
Boys and Girls						
1	125	3.7	131	7.4	134	7.1
2	117	3.3	117	6.3	119	11.7
3	113	3.1	117	8.3	113	6.6
4	107	5.1	100	10.2	106	9.1
Total	115	5.6	115	11.3	118	11.2

An examination of the reading quotients given in Table 3 indicates a situation similar to that for the intelligence quotients. The reading ability of the children on the whole is high as indicated by a median of 115 for the total group. There is, however, greater variability in quotients as shown by the fact that the quartile deviations for every group are nearly twice as large as the corresponding quartile deviations for intelligence quotients. This greater variability is also shown by the fact that the difference between the median reading quotient of leadership group 4 and leadership group 1 is 30 (131 - 101), while the difference between the median intelligence quotients for these two groups is 18 (125 - 107).

The total arithmetic quotients given in Table 3 present a picture practically the same as that shown by the reading quotients, except that the arithmetic medians run somewhat higher than the reading medians. None of the groups is low but the variability is greater than for the intelligence quotients. The arithmetic quotients for computation and reasoning computed separately are not given in Table 3. The data for these phases of arithmetic show a similar situation as described for the total arithmetic quotients except that the median computation quotients are higher than the median reasoning quotients for each leadership and sex groups. The median reasoning quotient for the total group is 114 and the median computation quotient, 123. The median computation quotient for girls is 127 and the median reasoning quotient 115. For boys the median computation quotient is 118 and the median reasoning quotient 113.

INTERVIEWS

This section is an analysis of information obtained by means of a personal interview. Only the 63 children in leadership group 1 and the 60 children in group 4 are included in this part of the study. Inasmuch as it was necessary for one person to conduct all of the interviews, time did not permit including the pupils of groups 2 and 3.

It may be questioned whether the data thus obtained give a fair picture of the total group, since the middle half of the pupils were omitted. As will be seen, however, the differences in the two groups were usually not great and a pooling of the results of the upper and lower groups probably gives a fairly accurate picture of the entire group of children.

The two groups are also compared in an attempt to discover differences which might be used in discovering potential leaders, as defined in this study. Also from a guidance point of view it was hoped that a discovery of differences in pupils of such groups might make it possible to develop a guidance program better adapted to pupils of different levels of leadership ability. For example, are there significant differences in the interests or the home backgrounds of pupils who rank high in intelligence, scholastic achievement, and on general personality ratings by teachers as compared with children who rate low on these three measures, that should be taken into account in the guidance program? It is recognized that in the final analysis guidance is an individual matter but in schools children must be dealt with both in groups and as individuals. Therefore, knowledge of general group tendencies is helpful in an attempt finally to know each individual pupil thoroughly and provide the education which is best for individual pupils.

The students were informed that the information was being obtained in order that those in charge of the school might be able to adjust the school program to the needs of the students. As all cooperated in an excellent spirit, it is felt that the data obtained are reliable in so far as the students were able to give accurate responses.

The data obtained by use of the interview were grouped under the following main headings and will be analyzed in the order given:

1. Family relationships and home and community backgrounds.
2. Interests.
    a. General.
    b. Social, recreational, and cultural.
    c. School.
    d. Vocational.
    e. Religious.
3. Emotional and imaginative life.
4. Mental and physical health.

FAMILY RELATIONSHIPS AND HOME AND COMMUNITY BACKGROUND

Magazines Read by Parents

The parents most frequently read such magazines as "The Saturday Evening Post," "Good Housekeeping," and "The Ladies Home Journal". About 25 per cent read some magazine of a non-fiction type. Group 1 parents read more magazines of a substantial non-fiction type.

Books in The Home

Fifty-six per cent of the parents of the children in this study had 125 or more books in the home while only 13 per cent had fewer than 25 books. The differences between the parents of group 1 and 4 were small. While numbers of books are not indicative of the kind or quality of books, the numbers give some notion of this phase of the home backgrounds of the children.

Where Children Spend Their Evenings

On the average the children reported spending 5.4 nights a week at home. The girls spent an average of 5.7 nights at home and the boys 5.1. Group 1 were home 5.7, and group 4, 5.2 nights a week. The indications are that girls spent more evenings at home than boys and the children of group 1 were at home more evenings than the children of group 4.

What Pupils Do Evenings

An average of 4.6 nights a week the children listened to the radio at least part of the evening. They studied some, 3.9 evenings a week, read 3.9 evenings, and played games .9 of an evening. The girls studied more and read more than the boys. Also group 1 children read and studied markedly more than the children in group 4, but played games somewhat less.

Evenings Children Have Had Children Come to Their Home or Have Gone to Friends' Homes.

Group 4 had friends come to their home or went to friends' homes less frequently than group 1. This is particularly true of the group 4 girls, as 75 per cent of them had not had a friend visit them and 71 per cent had not gone to a friend's home in the week reported.

Where Children Play

The children played most frequently in backyards, with vacant lots next in frequency. The boys played more in vacant lots than girls, while the girls played more often in back yards at home and in the park than did boys. Group 1 played more often in back yards at home or at a friend's home than group 4 but they played less at the park.

Play with Sibs

About one-third of the children were either only children or had no brothers or sisters at home at the time of this study. The girls spent more time with sibs than boys. More of group 1 than group 4 did not have a sib at home but of those who did a larger percentage than of group 4 spent much time with them.

Tell Mother or Father Troubles and Joys

An analysis of these data indicated no appreciable differences between groups 1 and 4. For the boys of both groups combined, 51 per cent said they often told their mother their troubles and joys and 30 per cent told their fathers. Of the girls 76 per cent confided in their mothers, and 39 per cent in their fathers. There is an indication that girls of this age confide in their parents more often than boys, and both boys and girls confide more in their mother than in their father.

Unfairness, Unreasonable Demands and Favoritism

Only 5 per cent of the children said they thought their parents or others were unfair to them. Four per cent said they thought another child in the family was favored. Of these, 19 per cent of the boys and 9 per cent of the girls thought other children were favored.

Nervousness of Parents

Nineteen per cent of the children thought their mothers were often nervous and 26 per cent that they were sometimes nervous. Only 5 per cent thought their fathers were often nervous and but 9 per cent that they were sometimes nervous.

Methods of Discipline

The methods of discipline in order of frequency of mention were: reasoning, scolding, and deprivation of pleasures. Seventeen per cent said they were not disciplined at all.

Things Parents Do Not Like

Table 4 indicates the things the children did which they said their parents did not like. Coming home late, quarreling with sibs, teasing sibs, and disobedience lead the list. Twenty-four children said they did not do anything their parents disliked. Many other behaviors were listed once or twice.

TABLE 4

NUMBER OF CHILDREN MENTIONING THINGS PARENTS DID NOT LIKE

	Fathers and mothers combined
None	24
Coming home late	17
Quarreling with sib	15
Teasing sib	12
Disobedience	11
Carelessness	7
Forgetting	6
Bad companions	4
Untidiness	4
Smoking	4
Too noisy	3
Won't practice music	3

Reading Aloud in the Home

No one had read aloud in the home in the previous month in 77 per cent of the families represented. In 21 per cent of group 1 homes and in 15 per cent of group 4 homes some one had read aloud three or more times.

Games or Sports Played by Parents

Cards, golf, swimming, and tennis were the leading games or sports of fathers, in the order named. For mothers the order was cards, swimming, and golf. Seventeen per cent of the fathers and 22 per cent of the mothers played no games or sports, according to their children. About half of the parents sometimes played these games or sports with their children.

Help at Home

About 90 per cent of the children said they helped with the work at home. The duties most frequently mentioned were: setting the table, running errands, caring for own room, mowing the lawn, and weeding the garden.

Radio in Home and Study With Radio

All of the children but one girl in group 1 came from a home which had a radio. About 40 per cent of the children in group 1 studied with the radio on and about 17 per cent of group 4. The difference is puzzling. Most of the children who studied with the radio on thought it did not bother them while most of the others thought it did. It would be interesting to know more about the part played by parents in this matter.

Allowance

Table 5 indicates the percentages of children who were given an allowance and the percentages who earned money. Group differences are small but more girls in both groups had allowances whereas more boys earned money. The median weekly allowance was $1.00 and the range from $.25 to $2.60. Money was earned most frequently by running errands, doing odd jobs, caring for children (girls only), shoveling walks, and mowing lawns.

TABLE 5

PERCENTAGES OF CHILDREN GIVEN AN ALLOWANCE AND EARNING MONEY

	Groups								
	1			4			All		
	Boys	Girls	All	Boys	Girls	All	Boys	Girls	All
Allowance	52	60	57	47	58	52	49	59	54
Earning Money	76	45	56	86	50	72	81	45	61

INTERESTS--GENERAL

Travel

Of the children studied, one per cent had traveled abroad, 60 per cent had been in five or more states other than New York, 30 per cent had been in one to four states other than New York, and 10 per cent had never been out of New York.

Clubs and Organizations Outside School

Membership and Offices.

Forty per cent did not belong to any organization. The organization most frequently mentioned by both boys and girls was the scouts. Forty-five per

nged to this organization. Twenty-two per cent held some office in
ization. (29 per cent of the girls and 12 per cent of the boys.)
nine per cent of group 1 held offices and 13 per cent of group 4.
e most often held was that of patrol leader.

tion of Clubs or Groups

children of group 1 had been somewhat more active in organizing
d gangs, especially the boys. The organizations most frequently men-
the order of frequency were, secret clubs, 21 per cent; athletic clubs,
ent; dramatic organizations, 8 per cent; sewing, social and detective
ions, each 5 per cent. Many others were mentioned less frequently.

Out of School Liked Best

y activities were mentioned by one or two children, but sports and
were most frequently given. Table 6 gives the percentages of these
vities. It may be noted that 24 per cent of group 1 and but 8 per
group 4 gave reading. The girls in both groups gave reading more
y than the boys. There are indications here that the children in group
ports better than the children in group 1 and were less fond of read-

TABLE 6

PERCENTAGES OF CHILDREN LIKING ACTIVITIES OUT OF SCHOOL

	Groups								
	1			4			All		
	Boys	Girls	All	Boys	Girls	All	Boys	Girls	All
	62	55	57	83	75	80	75	62	68
	10	31	24	3	17	8	5	26	16
	28	14	19	14	8	12	20	12	16

INTERESTS--SOCIAL, CULTURAL, AND RECREATIONAL

iked Best

le 7 indicates the sports given by 10 per cent or more of the children
st choice. Swimming was most popular for the children as a whole
cent). It was most popular for the girls in both groups, and for the
group 4, football was most popular.

TABLE 7

PERCENTAGES OF FIRST CHOICES OF SPORTS LIKED BFST

	Groups								
	1			4			All		
	Boys	Girls	All	Boys	Girls	All	Boys	Girls	All
	62	79	73	44	63	52	51	73	62
ing	33	14	21	22	50	33	25	39	32
all	29	33	32	47	25	38	42	18	29
	38	17	24	42	13	30	40	15	26
	38	0	13	61	0	37	53	0	24
	14	17	16	14	17	15	14	17	15
	14	14	14	11	8	10	12	12	12
	10	17	14	0	13	5	4	15	10
	5	17	13	8	0	7	7	12	10

Magazines Read

Table 8 gives the percentages of children reading various magazines in one month. It is evident that the children of group 1 read more magazines. Thirty-three per cent of the girls in group 4 had not read a magazine in a month. There are also indications that both the boys and girls in group 1 read a greater variety of magazines, particularly of non-fiction type.

TABLE 8

PERCENTAGES OF CHILDREN READING MAGAZINES IN ONE MONTH

Magazine	Groups								
	1			4			All		
	Boys	Girls	All	Boys	Girls	All	Boys	Girls	All
Boy's Life	33	0	11	44	8	30	40	3	20
Am. Boy	52	2	19	31	0	18	39	2	18
Open R'd. for Boys	43	2	16	31	4	20	35	3	17
Am. Girl	5	31	22	0	29	12	2	30	17
Sat. Evening Post	19	10	13	25	8	18	23	9	15
Child Life	14	31	25	0	8	3	5	23	15
None	5	14	11	8	33	18	7	21	15
Good Housekeeping	0	21	14	8	8	8	5	17	11
Literary Digest	10	10	10	11	8	10	11	9	10
Ladies Home Jr.	5	21	16	0	8	3	2	17	10

Books Read Not Required by Teacher

Table 9 gives the number of books read in one month not required by the teachers. Group 1 children had read a great deal more. Thirty-five per cent of group 4 and but 3 per cent of group 1 had not read one book. Sixty-one per cent of group 1 and but 26 per cent of group 4 had read three or more books. More girls than boys had read two or more books and of the girls in group 4, 46 per cent had not read one book.

TABLE 9

PERCENTAGES OF CHILDREN READING BOOKS NOT REQUIRED BY TEACHER

No. of books	Groups								
	1			4			All		
	Boys	Girls	All	Boys	Girls	All	Boys	Girls	All
0	0	5	3	28	46	35	18	20	18
1	19	7	11	39	8	27	32	8	18
2	24	26	25	14	8	12	18	20	18
3	24	31	29	17	29	21	19	30	25
4	14	10	11	0	4	2	5	8	7
5	10	14	13	0	4	2	4	11	7
6+	9	7	8	2	1	1	4	3	7

Radio Programs Listened to and Liked

Only four children said they did not like to listen to the radio at any time. Table 10 gives the percentages of children listening to various types of programs and the number of hours they listened each day. The children often gave two or three types as of equal interest, hence the table indicates the frequency of mention rather than first choices. The table shows that 66 per cent of the children listened an hour or more a day and 11 per cent listened three hours or more. As many children studied with the radio on, they probably listed time so spent as both studying and listening to the radio. Humorous sketches were most popular. Popular music was liked by more group 4 than group 1 children. The table does not give data for sexes as the differences were not significant.

TABLE 10

TIME SPENT LISTENING TO RADIO AND PROGRAMS LIKED, IN PERCENTAGES OF CHILDREN

	Groups		
	1	4	All
Three hours or more	11	10	11
One to three hours	61	71	66
Less than one hour	39	29	34
Programs liked			
Humorous sketches	86	83	85
Plays	40	55	47
Popular music	27	62	43
Classical music	16	15	15

Attendance at Movies and Pictures Liked

Of the 128 children studied, 11 went to movies more often than once a week and 28 went less often than once a week. Ninety per cent said they liked movies if they were the right kind. Table 11 gives the percentages of children liking different types of movies. The children gave the types of movie that they liked and these were then tabulated according to the classification given in the table. Group 1 children liked dramatic pictures better than group 4, whereas group 4 children liked mystery stories better than group 1. More girls than boys liked romantic pictures.

TABLE 11

PERCENTAGES OF CHILDREN LIKING DIFFERENT TYPES OF MOVIES

	Groups								
	1			4			All		
Type of Movie	Boys	Girls	All	Boys	Girls	All	Boys	Girls	All
Dramatic	52	31	37	9	8	8	25	23	23
Humorous	24	7	13	11	8	10	16	8	11
Mystery	5	5	5	14	17	15	11	9	10
Romantic	0	26	17	0	4	2	2	17	9
Juvenile	0	26	17	0	0	0	0	15	9

Children Who Like Parties and Can Dance

As shown in Table 12, groups 1 and 4 were similar in liking parties but more girls could dance (83 per cent as opposed to 68 per cent of the boys). The reasons most frequently given for liking parties were that they liked dancing and games.

TABLE 12

PERCENTAGES OF CHILDREN WHO LIKED PARTIES AND COULD DANCE

	Groups								
	1			4			All		
	Boys	Girls	All	Boys	Girls	All	Boys	Girls	All
Like parties	76	95	89	89	83	87	84	88	87
Can dance	38	83	68	69	83	76	58	83	71

Special Chums

Seventy-seven per cent of the children said they had a special chum. No group or sex differences were found. The chief reasons given for liking the chum were: likes the same games and sports, can do interesting things, and have known a long time.

Apparently children are not really well aware of reasons for liking a chum for they evidenced difficulty in expressing reasons.

Eighty per cent of the children said they liked to have a great many friends. A few said they preferred a few close friends. Only 7 per cent said they liked to play alone. Seventy-nine per cent said they belonged to a play group or gang. Considering groups, 73 per cent of group 1 and 87 per cent of group 4 said they belonged to a play group.

There are indications that group 4 children were somewhat more socially inclined than group 1 children.

INTERESTS--SCHOOL

Reasons for Liking the School

No clear differences between groups or sexes were discovered in studying the answers to this question. The reasons for liking the school most frequently given by all the children in this study in order of frequency of mention were: liked the teachers, liked the school work, liked the social activities, liked the methods of teaching, liked the way the school was run, and liked the extra-class activities.

Suggestions for Improving the School

Many suggestions for improving the school were given but most of these were related to improvement of school discipline and routines, and to a better extra-class activities program. It is interesting that in general these children wanted the school to be orderly. Forty-one of the 123 pupils interviewed said they would prefer better discipline in classes than now prevails. Even children with a record of misbehavior frequently expressed the belief that teachers ought to maintain good order. As one child said, "Teachers should be more strict; children will make more noise if the teacher lets them, but nobody really enjoys a noisy classroom." The suggestions of the children in group 1 were in general more constructive and detailed than those of the children in group 4. Group 1 children more frequently mentioned matters pertaining to student government while group 4 children more frequently mentioned extra-class activities.

Reasons for Working for Good Grades

Table 13 was prepared by grouping the many answers of the children to this question. Preparation for college was mentioned most frequently even by group 4 children. A high percentage of pupils in the Milne school go to college but many of the children giving this reason probably did so because it is "the thing to do" or at least to say you are doing. Group 1 children frequently said they were working for good grades to please their parents and because of the satisfaction they got from the work. Group 4 children stressed preparation for vocations. Twelve per cent of this group said they were mainly concerned with getting through school. Of the 14 per cent who gave no reason many probably belong in this classification. It should be remembered that in general the grades of group 1 children were much higher than those of group 4 children so that they were achieving success in this way, whatever may have been their motives. The small number of children, especially in group 4, mentioning satisfaction in the work, may indicate a lack of intrinsic motivation in much of the work.

TABLE 13

REASONS FOR WORKING TO MAKE GOOD GRADES, IN PERCENTAGES OF CHILDREN MENTIONING

	Groups								
	1			4			All		
Reasons	Boys	Girls	All	Boys	Girls	All	Boys	Girls	All
College preparatory	38	24	28	38	24	28	43	25	33
Vocational preparatory	20	11	15	30	47	47	22	31	24
To please parents or teachers	33	38	37	6	8	7	17	28	20
No reason	14	28	26	8	17	14	13	27	19
Satisfaction in the work	10	36	27	9	4	6	12	23	16
Competition	15	12	13	8	17	14	12	8	9
Get through school	5	0	2	17	4	12	12	2	7
Avoid failure	0	0	0	6	0	3	2	0	2

Subjects Liked and Disliked

Table 14 gives the subjects the children said they liked or disliked most for groups 1 and 4 combined. Only subjects taken by all the children were included in this comparison. The data for groups 1 and 4 are not given separately as no clear differences were found.

For the children as a whole no subjects were outstandingly popular or unpopular. English was far more popular with the girls and mathematics with the boys.

TABLE 14

SUBJECTS LIKED AND DISLIKED, IN PERCENTAGES OF CHILDREN

	Liked best			Disliked most		
	Boys	Girls	All	Boys	Girls	All
Mathematics	25	15	19	14	24	19
English	5	26	16	28	8	17
Social studies	14	9	11	9	18	14
Science	14	6	10	12	17	15
Other subjects or none mentioned	42	44	44	37	33	35

The dislikes were in agreement with this trend. More boys disliked English than any other subject, whereas more girls disliked mathematics than any other subject.

The reasons given for liking or disliking subjects were too indefinite to be very meaningful. There were, however, indications that subjects were liked if the children could get them easily, if they made good grades, or if they liked the teacher. Very few children said subjects were liked because they were interesting.

Clubs Liked Best

There were indications that the children liked best the clubs they planned and ran largely by themselves. They did not like teacher organized and dominated clubs. Clubs that involved outdoor activities were especially popular.

Offices in School Clubs

Fifty-three per cent of group 1 children held some office in a school club or school organization at the time of this study, whereas 35 per cent of group 4 children held offices. Boys held more offices than girls.

Time Spent in Home Study Each Day

Table 15 gives the numbers of hours the children studied at home each day. Eighty-three per cent of the children studied two hours or less per day while 17 per cent studied more than two hours. Group 1 children studied somewhat less at home. Eleven per cent studied two hours or more, whereas 25 per cent of group 4 studied two hours or more.

TABLE 15

TIME SPENT IN HOME STUDY EACH DAY, IN PERCENTAGES OF CHILDREN

Hours	Groups		
	1	4	All
3+	0	4	2
2 to 3	11	18	15
1 to 2	41	44	43
1-	48	34	40

INTERESTS--VOCATIONAL

Vocational Choices

Table 16 shows that in general boys chose engineering, medicine, and farming most often with 26 per cent undecided. Girls chose teaching, commerical work, and nursing most often.

TABLE 16

VOCATIONAL CHOICES, IN PERCENTAGES OF NUMBER OF CHILDREN

	Groups					
	1		4		All	
	Boys	Girls	Boys	Girls	Boys	Girls
No choice	38	7	19	13	26	9
Teacher	0	38	0	42	0	40
Engineer	10	0	33	0	25	0
Stenographer or secretary	0	12	0	33	0	17
Doctor	14	0	11	0	12	0
Nurse	0	7	0	8	0	8
Farmer	14	0	6	0	9	0
Others	24	36	31	4	28	26

More boys in group 1 than in group 4 were undecided. Group 4 boys were especially frequent in the selection of engineering. Thirty-three per cent of group 4 girls and 12 per cent of group 1 girls selected commercial work. Group 1 girls had a wide variety of scattered choices as indicated by the fact that 36 per cent chose occupations other than the ones most frequently given as listed in the table. Only 4 per cent of group 4 girls had other choices.

The data secured by the question relative to parents' vocational choices, was compared with the children's choices. Thirty-two per cent of the parents had not made a choice according to the children, 31 per cent agreed with their children, 27 per cent were willing for the child to follow his own choice and 10 per cent disagreed with the children's choices. Group and sex differences were slight.

INTERESTS--RELIGIOUS

Church Membership and Attendance

Eighty per cent of the children belonged to church with sex and group differences negligible.

As to attendance at Sunday school or some other religious school, 78 per cent often went, 4 per cent went sometimes and 17 per cent seldom went. Seventy per cent of the boys as compared with 91 per cent of the girls went often or sometimes. There were no group differences. Seventy-two per cent of all the children said they liked to go. Seventy-nine per cent of the girls liked to go and 66 per cent of the boys. For the groups, 60 per cent of group 1 and 85 per cent of group 4 liked to go. The indications are, that the girls went more often and more often liked to go than boys and that while both groups went about equally often, more of group 4 liked to go.

The reasons most frequently given for liking to go were that the lessons were interesting, they liked the teacher, they met their friends, they learned something, and they met nice people.

When asked why they went to church, 51 per cent said they enjoyed it, 25 per cent said because they were in the habit, 22 per cent said their parents sent them, and 9 per cent said they felt it was a duty. Again the indications are that more of group 4 children than group 1 went and more of them liked to go.

EMOTIONAL AND IMAGINATIVE LIFE

Worries

Thirty-nine per cent of the children said they worried about various things. School work was the cause given in most cases, although a few children said they worried about members of the family who were ill and about their own health. More of group 4, and especially the girls, said they worried about school work. This not surprising as, in general, their school success was not nearly as satisfactory as that of the children of group 1. The tests and examinations seemed to be the chief source of worry with inability to do the work also a common source, especially in group 4. Seven per cent worried because they could not keep up with home work.

Admittedly the term "worry" is indefinite and it is unsafe to make any very definite conclusions upon the basis of the response of the children to the questions asked. Their answers, however, may indicate certain trends.

Fears

About 60 per cent of the children said they were afraid of something. In order of frequency of mention the fears were: snakes, dogs, the dark, storms, accidents, high places, strange noises, being alone at home, burglars, and the unknown.

Anger

The things that made them most angry were mentioned in the following order of frequency: being teased, people unfair to them, a sibling taking their property or imposing on them, people lying to them, things not going right, people being sarcastic, and people being bossy.

Dreams

Eighty-one per cent of the children said they seldom had dreams, 17 per cent sometimes had them and 2 per cent had them often.

The things most frequently dreamed about in order of frequency of mention were: falling, scary movies, being hurt, animal after them, kidnapping, something they had read, and dreams that were not remembered. A great variety of things were given less frequently.

Imagination

Table 17 gives the percentages of children who said they liked to sit and imagine things. Such data are of course quite unreliable due to the vagueness of the term. The data seem to indicate, however, that the children in group 1 were more inclined to be imaginative than those in group 4. Also girls were more imaginative than boys.

TABLE 17

PERCENTAGES OF CHILDREN WHO LIKED TO IMAGINE THINGS

Groups								
1			4			All		
Boys	Girls	All	Boys	Girls	All	Boys,	Girls	All
67	81	76	50	75	60	56	79	68

Table 18 gives the things the children said they liked best to imagine. The girls most frequently liked to make up stories to play while the boys liked to imagine themselves as grown up.

TABLE 18

WHAT CHILDREN LIKED BEST TO IMAGINE, IN PERCENTAGES OF CHILDREN

	Boys	Girls	All
Make up stories to play	16	53	35
When they are grown up	28	38	33
Traveling	5	8	7
Inventions that may be made	11	0	5
Make up games	7	2	4
Winning fame	3	2	2
Happenings on other planets	4	2	2

Original Writing

Sixty per cent of group 1 children and 40 per cent of group 4 children said they had written original stories, poems, and music. In both groups the girls had much more frequently done so than the boys.

Wishes

The children gave a great variety of specific responses when asked the three things they would most like to have. In Table 19 these are grouped under the general headings indicated. The figures indicate the percentages of children wishing one or more of each type. Ownership of things was most frequent for boys and girls, with all the boys and 80 per cent of the girls wishing for something which came under this heading. In matters of travel and emotional security, the girls' wishes were considerably more frequent than the boys.

TABLE 19

TYPE OF WISHES, IN PERCENTAGES OF CHILDREN, WISHING ONE OR MORE OF EACH TYPE

Type	Boys	Girls	All
Ownership	100	85	92
Self development	26	24	25
Travel	18	29	23
Vocational	11	15	13
Economic security	40	32	35
Emotional security	7	18	13
Pleasures	9	8	8
Health	7	12	10
Altruistic	2	8	5
Escapes	5	0	2

MENTAL AND PHYSICAL HEALTH

Sickness and Accidents

Thirty per cent of the children had been sick in bed during the previous six months and 34 per cent had at sometime had an accident or serious illness. The percentages were approximately the same for groups and sexes.

Examinations by Doctors and Dentists

Forty-seven per cent of the children had been examined by a doctor outside of school within the previous six months. Fifty-six per cent of group 1 children and 40 per cent of group 4 children had been examined.

Seventy-six per cent of the children visited a dentist twice or more a year, 10 per cent when needed, and 14 per cent never visited a dentist.

Sleeping Conditions

Eighty-three per cent of the children slept in bed alone and 68 per cent in room alone. No group or sex differences were found.

Eating Habits

Approximately 70 per cent of the children said there were some foods they particularly disliked but 30 per cent said they sometimes ate these foods.

Eighty per cent had eaten between meals the day before the interview, usually after school in the afternoon. Thirty-five per cent had eaten before going to bed.

There were no especial group or sex differences in eating habits except that a somewhat higher percentage of boys than girls ate between meals during the day.

Amount of Sleep

Table 20 shows the average number of hours sleep a night for one week. Fifty-eight per cent of group 1 children got ten or more hours of sleep a night as did 37 per cent of group 4. An examination of the variation for different nights showed that about 90 per cent of the children interviewed had fairly regular hours.

PERSONALITY RATINGS

As previously stated, the 250 children in this study were rated by their teachers on the Hayes, "Scale for Evaluating the School Behavior of Children Ten to Fifteen." Each child was rated by each of his teachers so that the

TABLE 20

AVERAGE NUMBER OF HOURS SLEEP A NIGHT, IN PERCENTAGES OF CHILDREN

Hours	Groups 1 Boys	 Girls	 All	 4 Boys	 Girls	 All	 All Boys	 Girls	 All
11+	0	0	0	0	4	2	0	2	1
10-11	67	54	58	30	44	35	44	50	47
9-10	34	45	42	66	50	60	55	47	51
8-9	0	0	0	4	2	3	1	1	1

average number of ratings for each child was approximately four. Thus the total number of ratings was about 1000.

Table 21 gives the percentages of children whose rating scores were above and below the medians for the children used to establish norms by Hayes. These are given for total scores on this 100 item scale and for each of the eight sub groups of items. Boys and girls are given separately and combined

TABLE 21

PERCENTAGES OF CHILDREN WHOSE PERSONALITY RATING SCORES WERE ABOVE OR BELOW THE NORM MEDIAN ON THE HAYES RATING SCALE

Above or Below Median	Groups 1 Boys	 Girls	 All	 4 Boys	 Girls	 All	Groups 1, 2, 3, and 4 combined Boys	 Girls	 All
Total Personality Scores									
Above	82	97	93	39	41	41	56	78	69
Below	18	3	7	61	59	59	44	22	31
Relations to others generally									
Above	76	96	89	50	50	50	66	85	78
Below	24	4	11	50	50	50	34	15	22
Respects for rights of others									
Above	38	69	58	28	46	42	40	62	52
Below	62	31	42	72	54	58	60	38	48
Relations to Teachers									
Above	34	54	48	17	25	20	38	44	41
Below	66	46	52	83	75	80	62	56	59
Relations to other Pupils									
Above	66	96	86	47	38	44	56	82	71
Below	34	4	14	53	62	56	44	18	29
Initiative									
Above	75	83	81	35	32	35	54	64	61
Below	25	17	19	65	68	65	46	36	39
Health Habits									
Above	76	97	88	29	64	42	54	84	72
Below	24	7	12	71	36	58	46	16	28
General Interests									
Above	86	81	83	36	29	33	55	65	61
Below	14	19	17	64	71	67	45	35	39
Study Habits									
Above	66	98	87	36	41	38	49	79	64
Below	34	2	13	64	59	62	51	21	36

for groups 1 and 4 and for the four groups combined.

For the total group of children 69 per cent were rated above the median norm on total score. On the sub groups of items the children were rated especially low on "Relations to Teachers" and comparatively low on "Respect for Rights of Others."

On total score and on every sub group of items the boys were rated lower than the girls with the same general trend with respect to groups of items as for boys and girls combined. The girls were rated higher particularly on Health Habits, Study Habits, and Relations to Other Pupils. While ratings are not to be considered as giving a very accurate portrayal of personality, certainly the data presented here indicate that, as judged by the teachers, the boys were not making on the average nearly as satisfactory adjustments as the girls. The cause may lie in the failure of the school to establish an environment as suitable for boys as for girls or it may reveal a tendency for women teachers, as most of the raters were, to rate girls higher than boys. Whatever the cause or causes, the consistent differences should challenge the careful consideration of those responsible for planning the educational environment of adolescents.

Comparing group 1 and group 4 children, a striking difference is found between the percentage rated above the median norm on total personality score and on all sub groups of items. Apparently, with respect to all types of behavior relating to school situations the group 4 children were considered inferior in their adjustments by the teachers who rated them. These were children who were not succeeding very well in scholarship in the school, whose intelligence quotients were comparatively low, and who were considered relatively low in personality adjustment when the groups were first made up. It is not surprising then that they should be rated so much lower on this scale than group 1 children, who were selected on the basis of good adjustments to school situations. It is interesting to speculate whether group 4 children are generally more poorly adjusted to life or whether the school is not adapted to them.

HEALTH RATINGS

As a part of the regular health program of the Milne School each child is given a thorough physical examination by the school physician near the beginning of each school year. In addition to the detailed recording of the results of the examination, each child is given a general health rating. A rating of A indicates excellent health and freedom from physical defects, B indicates good health, C indicates fair health, D indicates poor health, and E indicates very poor health.

The percentages of the 250 children given the various health ratings at the beginning of this study were as follows: A, 29 per cent; B, 45 per cent; C, 22 per cent; D, 3 per cent; E, 1 per cent. There were no significant sex or group differences. While the ratings are too general to be considered as objective evaluations, they furnish indications that in general this was a group of children who were in good health and relatively free from serious defects.

The percentages of all children included in this study with the various physical defects indicated were as follows: underweight, 17 per cent; eye defects, 13 per cent; defective tonsils, 10 per cent; dental defects, 10 per cent; overweight, 5 per cent; ear defects, 3 per cent; heart defects, 2 per cent. These defects were found in approximately the same frequency in both boys and girls except that 16 per cent of the girls had defective eyes and but 9 per cent of the boys.

For groups 1 and 4 the frequency of defects was also approximately the same except for eye defects. Seventeen per cent of group 1 had eye defects but 7 per cent of group 4. In these two groups sex differences were not found.

bookkeeping, and typing), but there were not more than 7 students in any one of these classes from groups 1, 2, 3, and 4 combined, so they are not included in Table 23.

TABLE 23

MARKS IN SCHOOL SUBJECTS FOR ONE YEAR

	Groups						Groups 1, 2, 3, and 4								
	1			4			Boys			Girls			All		
Subject	No.	Med.	Q	No.	Med.	Q	No.	Med.	Q	No.	Med.	Q	No.	Med.	Q
Latin	25	83	5.7	10	65	4.6	26	68	7.6	56	75	6.7	82	74	6.5
French	19	86	5.8	8	66	6.0	22	79	8.2	39	84	6.7	61	82	6.0
History	11	85	4.3	16	77	6.8	28	85	6.8	26	83	5.6	54	84	6.3
Civics	10	88	2.7	11	76	2.8	15	81	4.2	27	86	3.8	42	84	4.5
Math	53	91	4.7	48	76	5.0	81	82	6.9	121	84	7.5	202	83	7.2
English	62	90	3.5	57	78	3.4	99	81	5.1	143	86	5.0	242	84	5.6
Art	18	85	6.8	21	78	2.5	35	80	4.2	50	84	5.8	85	81	4.2
Industrial Art	31	86	3.7	30	80	3.0	51	81	2.7	72	84	3.8	123	83	3.4
Science	44	90	4.3	43	81	5.1	75	84	5.5	99	83	4.9	174	84	5.1
Social Studies	30	90	1.9	29	79	2.8	49	85	4.3	69	85	5.0	118	85	4.7
Social Language	15	92	4.4	14	83	3.0	22	85	4.9	36	87	4.6	58	86	4.1

Table 24 shows the percentages of children skipping or repeating one or more grades in the first six grades. More children in group 1 than in group 4 skipped grades.

TABLE 24

PERCENTAGES OF CHILDREN REPEATING AND SKIPPING ONE OR MORE GRADES IN THE FIRST SIX GRADES

	Groups						Groups 1, 2, 3, and 4		
	1			4					
	Boys	Girls	All	Boys	Girls	All	Boys	Girls	All
Grades skipped	33	36	35	8	4	5	20	22	21
Grades repeated	10	5	6	22	13	18	16	8	11

For all groups combined, 20 per cent of the boys had skipped grades and 16 per cent had repeated grades. Of the girls 22 per cent had skipped grades and 8 per cent had repeated grades. Here again is evidence that the girls adjust to the school program better than the boys, since fewer of them had to repeat grades.

SUMMARY

The data reported in this study will be summarized under three headings: general trends, sex differences, and group differences. (Leadership group 1 compared with leadership group 4.)

I. General Trends

1. The children in this study generally came from homes with a high occupational status in which the average number of children was 2.4.
2. The median I.Q. was 115.
3. Fifty-six per cent of the homes had 125 or more books in the home.

4. The children spent an average of 5.4 nights a week at home, usually listening to the radio, reading, or studying. If not at home they most frequently went to the movies, visited friends, or had a date.

5. They much more frequently told their troubles and joys to their mother than to their father.

6. They thought their mothers were much more often nervous than their fathers.

7. The methods of discipline most often used by their parents were: reasoning, scolding, and depriving of pleasures.

8. The things the children did that their parents disliked most were: coming home late, quarreling with sibs, teasing sibs, and disobeying parents.

9. About 60 per cent of the parents played some games and sports with their children.

10. Most of the children helped some with the work at home such as setting the table, running errands, and caring for their room.

11. Half of the children had an allowance. Sixty-one per cent earned some money.

12. Sports and reading were the out of school activities liked best. Swimming was the most popular sport.

13. A majority of the children had read a good many books and magazines not required by the teachers.

14. Humorous sketches were the most popular radio programs.

15. The children went to the movies on average of about one night a week. Dramatic and humorous movies were liked best.

16. Most of the children could dance and liked to go to parties.

17. The children wanted the teachers to keep good order in the classrooms.

18. Clubs which were not teacher dominated were liked best. Clubs involving out door activities were especially popular.

19. Eighty per cent of the children belonged to church. A majority of them went to Sunday school regularly.

20. The most frequent source of worry was school work.

21. The most frequent fears were: snakes, dogs, the dark, and storms.

22. The things that made the children most angry were: being teased, people being unfair to them, and a sib imposing upon them.

23. The children dreamed most often of: falling, scary movies, and being hurt.

24. The wishes they expressed were most often for material things.

25. Seventy per cent of the children had food dislikes. Eighty per cent ate between meals.

26. About 90 per cent of the children had fairly regular sleep habits, and 90 per cent got from 9 to 11 hours sleep a night.

27. Sixty-nine per cent of the total group of children were rated above the median by their teachers on the Hayes Personality Rating Scale. They were rated lowest on items concerned with relations to teachers and respect for rights of others.

28. On the health ratings, 29 per cent were rated A; 45 per cent, B; 22 per cent, C; 3 per cent, D; and 1 per cent, E. The most frequent physical defects were: under weight, eye defects, defective tonsils, and dental defects.

29. Marks on school subjects were fairly comparable for all subjects except that the average mark for Latin was much lower than for any other subject.

II Sex Differences

The data indicate that the boys in this study as compared with the girls:

1. Went out more evenings.
2. Played more often on vacant lots and in the streets.

3. More often earned some money.
4. Had organized more clubs and gangs.
5. Held more offices in clubs.
6. Expressed engineering as the first vocational choice, more often.
7. Liked studying mathematics better.
8. Made more verbal responses in the classrooms indicating command of subject matter and both desirable and undesirable aggressiveness.
9. Had more often repeated school grades.

The girls as compared with the boys:

1. Were at home more evenings.
2. Read and studied much more.
3. Played in backyards more often.
4. Played more with sibs.
5. More often told their mother their troubles or joys.
6. More often had an allowance.
7. Liked reading better.
8. Liked romantic movies better.
9. More often could dance.
10. Liked studying English better.
11. Gave teaching more often as the first vocational choice.
12. Worried more about school work.
13. More often said they liked to imagine games to play.
14. Had done more creative writing.
15. Were higher on total score on personality ratings and on all sub groups of items. They were especially high as to health habits, study habits, and relations to other pupils.
16. More often had eye defects.
17. Had higher school marks in all subjects but history, science, and social studies. In these they were about equal to the boys.
18. Had more often skipped grades in school.

III Group Differences

The data indicate that group 1 as compared with group 4:

1. Had more girls in proportion to boys as selected on the basis of combined measures of intelligence, school achievement, and personality.
2. Had a higher median intelligence quotient (125 as compared with 107); a higher reading quotient (131 as compared with 101); and a higher arithmetic quotient (133 as compared with 121).
3. Had parents who read more magazines of a substantial type.
4. Were at home more evenings.
5. Studied and read more magazines and books. The variety of reading was also greater.
6. Visited with friends more often.
7. Played more with sibs.
8. Held more offices in clubs and had organized more clubs and groups.
9. Liked dramatic movies better.
10. Made more constructive suggestions for improving the school.
11. More often worked to get good grades to please their parents.
12. Had a wider variety of vocational choices.
13. Were more imaginative and had done more creative writing.
14. Were rated higher with respect to all types of behavior included on the Hayes rating scale.
15. Had more eye defects.
16. Had higher school marks. The differences were greatest for Latin and French.
17. Had skipped more grades in school.

ASPECTS OF LANGUAGE DEVELOPMENT: THE GROWTH OF LOQUACITY AND VOCABULARY[1]

ARTHUR T. JERSILD AND RUTH RITZMAN[2]

This study deals with the growth of talkativeness and vocabulary during preschool years. The subjects were 88 two- to five-year-old children, above average in intelligence, enrolled in the nursery schools of the Child Development Institute during the period from 1928 to 1934. In the case of 73 children, the data include a verbatim record of the language used by the child during three mornings in the nursery school, representing approximately nine hours; each of the remaining 15 children was observed during two mornings, or for a period of about six hours.

These language records, which include what amounts to a rather lengthy booklet for each child, have been compiled under the auspices of the Child Development Institute. The data they contain may be approached from several angles. This study deals primarily with amount of talking and size of vocabulary as related to each other and to such factors as age, sex and intelligence. An earlier study by Fisher,[3] based upon data available at the time for seventy-two of the present 88 children, dealt mainly with an analysis of sentence structure and with the egocentricity and sociability of children as revealed by their language.[4] In an earlier study by Caille[5] a number of the records were analyzed in an investigation of resistant behavior; and the records were used also as a supplement to Murphy's study of sympathy,[6] and they are being analyzed from other points of view in a study, now in progress, by Peterson of imaginative behavior and in a study by Fite and Jersild of children's adjustments in the nursery school.[7]

Nature of the Data. The methods used in gathering the data have been described by Fisher, and need only be indicated briefly here. During each of the different days devoted to a given child, the child was followed by a person who was experienced both as a stenographer and as an observer of children. The child was observed from the time he entered school in the morning until he had finished his lunch and was ready for his afternoon nap. All vocalizations or remarks made during this time were recorded exactly as they sounded to the observer. The record also included an account of the situation in which each item of language occurred, of the language or behavior of playmates or of teachers, and of other events transpiring in the child's environment. An effort was made to complete all three of the records for each child within a single week. In seventy-one per cent of the cases, all records were completed within a week or less, but in the remaining instances, more than a week (and as

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[1] This study was conducted under the auspices of the Child Development Institute. The authors are grateful to Dr. Lois Hayden Meek, Director, for aid in conducting this study, and to Dr. Saul B. Sells for statistical assistance. They acknowledge also the aid of workers, supplied by the Works Progress Administration, under the classification Project Number 65-97-295, Sub-project 10, in tabulating the data.

[2] From Teachers College, Columbia University.

[3] Fisher, M. S. Language patterns of preschool children. Child Development Monographs, No. 15, 1934, 86 pp. Bureau of Publications, Teachers College, Columbia University.

[4] This paper refers to only a limited number of studies of language. For an excellent review of earlier literature, the reader is referred to McCarthy, D. Language development. Chapter IX in A Handbook of Child Psychology (C. Murchison, editor), pp. 278-316. Worcester, Mass.: Clark University Press, 1931.

[5] Caille, R. K. Resistant behavior of preschool children. Child Development Monographs, No. 11, 1933, 142 pp. Bureau of Publications, Teachers College, Columbia University.

[6] Murphy, L. B., Social Behavior and Child Personality. New York: Columbia University, 1937, 344 pp.

[7] Jersild, A. T. and Fite, M. D. The influence of nursery school experience on children's social adjustments. (Unpublished) For brief summary, see Jersild, A. T. and Fite, M. D. Children's social adjustments in nursery school. J. Exper. Educ., December, 1937, pp. 161-166.

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much as a month) transpired between the first and final record.

These stenographic records were subsequently typed in a three column arrangement: one column showed the elapse of time, another gave an account of the general situation in which the child was located, and of speech and behavior of other children and adults in the situation, and the third reproduced, verbatim, the speech of the subject.

Subjects. Table 1 shows the distribution of the subjects according to age, sex, and I.Q. Several I.Q. ratings were available for most of the children, but in each case the rating that was used was the one obtained in the mental test nearest in date to the time when the child's language was being recorded.

It can be seen from Table 1 that the children, with an average I.Q. of 132, are quite above average in intelligence, and therefore are more representative of bright children than of children of normal intelligence. Most of the children likewise were above average in socio-economic status. Although the I.Q.'s are on a high level, it still is possible to study the data in terms of chronological age and mental age, especially since the various age groups (with the exception of the two subjects in the range from 60 to 65 months) are quite similar in average I.Q.

Method of Tabulation. This report is based mainly on two tallies, (1) a count of the total number of words spoken by the child, and (2) a count of the total number of *different* words used. In making the first-mentioned count, a tally of one was allowed for each word, whether that word was used once

TABLE 1

DISTRIBUTION OF CASES BY AGE, SEX AND I.Q.*

Age Range to Nearest Month	Boys N	Mean IQ	Girls N	Mean IQ	All N	Mean IQ	S.D.
18-23	1	125			1	125	
24-29	3	116	8	136	11	130	16.2
30-35	11	125	9	139	20	131	17.03
24-35	14	123	17	137	31	131	16.4
36-41	10	125	12	136	22	131	16.1
42-47	13	133	13	136	26	135	14.1
36-47	23	130	25	136	48	133	15.2
48-53	3	130	2	128	5	129	18.8
54-59	1	138	1	155	2	147	8.6
48-59	4	132	3	138	7	139	19.1
60-65	1	116			1	116	
66-71							
60-71	1	116			1	116	
Total	43	127	45	137	88	132	15.88

* IQ's are based on the Kuhlmann-Binet scale, except in the case of six children, distributed among the various age groups, whose scores were based on the Minnesota Preschool scale.

or many times. For example, if a subject said "no" ten times, "yes" three times, and "boy" once, the score would be (1) 14 for number of words spoken, and (2) 3 for number of different words used. Totals were computed for each morning's record as well as for the entire series of records available in the case of a given child. The value for total number of words spoken during three mornings represented simply a cumulative total of the records of the separate days, but the count of the total number of different words used during two or three mornings represented again a tally of one only for each word, whether it occurred once or often in one or all of the separate records.

In counting the number of different words used, no proper nouns were tallied; plural forms were not tallied unless the singular had not been used; variants of verbs, adjectives and pronouns were not counted as separate words unless they were irregular or if the roots of the word were changed; childish forms of the same word were counted as different words (i.e., mother, mammy); two or more words representing a single concept counted as one word (kiddle-kar); childish designations were counted ("choo-choo" for train); incomprehensible words were not counted; slang expressions were counted; contractions of verbs and negatives (can't, won't) were counted as one word (except as noted elsewhere in this paper); each part of a verbal combination was scored as a separate word (e.g., "have been playing" represents three items). In the count of total *number of words spoken*, a tally of one was given to each word, or each grammatical form of a word, each time it recurred (with the exception that contractions were counted as one word).

Internal Consistency of the Data. To measure the consistency of the data and thereby to obtain some indication of the adequacy of the sampling represented by the available language records, correlations were computed between scores on different days. The correlation between total number of words spoken the first and the second day, in the case of 88 children, was .77 ± .03; the corresponding coefficient for total number of different words used was .82 ± .03. Similar correlations between the records of the second and the third, and the first and the third days likewise yielded coefficients above .70 or .80. With the factor of age partialled out, the coefficients obtained when the scores of the first and second days combined were correlated with the scores of the third day were .79 for number of words spoken and .74 for number of different words used.

RESULTS

Changes with Age. The increase in sheer quantity of speech is perhaps the most obvious indication of the rapid development of language during the early years of childhood. The tables that follow indicate the rate of this increase with age, and compare the change in amount of talking with increases in size of vocabulary. Table 2, which is based on all the subjects in the study, shows the number of words spoken and the number of different words used per three-hour period at tri-monthly, half-yearly and yearly chronological levels. Table 3 shows corresponding results when children are classed according to mental age.

Table 2 shows a rapid increase with age in amount of talking and in number of different words used.

Irregularities in the tri-monthly averages and in the averages for children over four years old, all of which include smaller groups of children, indicate that individual differences may be so pronounced as to overshadow age trends.[8]

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[8] The subject of individual differences will be touched upon again at a later point. It may be said here, incidentally, that conditions which might cause a fluctuation within a single child's behavior from day to day were controlled as far as possible while the data were being collected. No records were taken if a child's condition seemed abnormal in any way, as manifested by apparent unusual fatigue, crying spells, temper tantrums, the effects of recent illness, etc.

TABLE 2

DEVELOPMENT OF VERBOSITY AND VOCABULARY AS RELATED TO CHRONOLOGICAL AGE

Mean and median number of words spoken and of different words used per three hours by 88 two- to five-year-old children(a)

Age in Months	No. of Children	No. of 3 Hr. Records	No. of Words Spoken (T)			No. of Different Words Used (D)			Ratio of D to T(e)		
			Range	Mean	Median	Range	Mean	Median	Range	Mean	Median
Tri-monthly											
21-23	1	3	-(a)	202	202	-	51	51	-	.252	.262
24-26	4	12[b]	241- 434	336	335	60-112	79	73	.243-.297	.270	.267
27-29	7	20	236- 729	439	431	75-142	102	82	.200-.368	.256	.252
30-32	11	32	99-1370	691	682	36-273	139	131	.136-.418	.235	.212
33-35	9	26	299-1967	851	753	104-298	169	171	.201-.362	.253	.231
36-38	11	32	793-1620	1238	1112	137-275	272	213	.155-.288	.205	.186
39-41	11	33	396-1990	1354	1465	111-394	235	264	.201-.300	.211	.199
42-44	12	35	322-2723	1518	1502	117-552	284	282	.169-.400	.217	.194
45-47	14	38	1370-3084	1990	1803	259-500	332	325	.102-.250	.179	.178
48-50	3	8	322-1905	1450	1865	102-344	242	279	.184-.316	.232	.195
51-53	2	4	714-1384	1049[c]	1049	164-285	225[c]	225	.209-.246	.228	.228
54-56	1	2	-	1426	1426	-	337	337	-	.236	.236
57-59	1	2	-	1978	1978	-	359	359	-	.183	.183
60-62	1	2	-	599	599	-	107	107	-	.190	.190
Half-Yearly(d)											
24-29	11	32	236- 729	402	424	60-142	94	81	.200-.362	.261	.252
30-35	20	58	99-1967	763	718	32-298	153	161	.136-.418	.234	.228
36-41	22	65	396-1990	1296	1348	111-394	254	264	.155-.300	.208	.199
42-47	26	73	332-3084	1772	1761	117-552	309	311	.102-.400	.197	.183
48-53	5	12	322-1905	1238[c]	1310	102-344	235[c]	222	.184-.316	.230	.209
54-59	2	4	1426-1978	1702[c]	1702	337-359	248	348	.183-.236	.210	.220
Yearly(d)											
24-35	31	90	99-1967	636	512	36-298	131	114	.136-.418	.244	.234
36-47	48	138	332-3084	1533	1483	111-552	275	273	.102-.400	.202	.190
48-59	7	15	322-1978	1371[c]	1426	102-359	267[c]	285	.183-.316	.224	.209

(a) The score used for each child in computing the mean and the median represented the average score obtained by the child in two or three three-hour records

(b) See (a). The number of three-hour records varies according to the number of children who were observed only two forenoons instead of three. At 24-26 months, the value of 12 for "No. of Records" means that all four children were observed three times; at 27-29 months, the value 20, means that six children were observed three times and one child only twice.

(c) Two of the children aged 48-53 months had IQ's considerably below the average for the group as a whole; moreover, some of the children above 48 months in age were enrolled in kindergartens.

(d) Two children, one below two years and another above five years, are omitted.

(e) The ratio of number of different words used (e.g., size of vocabulary used during the period of observation) to total number of words spoken (representing a tally for each word and each repetition of a word) was computed for each daily record in the case of each child. The average of each child's daily ratios was used, in turn, in computing group means and medians. Mean ratios, therefore, do not necessarily correspond to values that would be obtained simply by computing ratios between group means.

The large variation among individual children is shown even more clearly in the range of the scores at various age levels. One of the children at 27-29 months, for example, has a score of 729 words spoken, as compared with a score of only 322 for one of the children in the group aged 48-50 months; again, a child at 24-26 months scores 112 in number of different words used during three hours as compared with a score of 102 for one of the children at 48-50 months.

According to Table 3, there is a sharp rise in number of words spoken and number of different words used at half-yearly chronological age intervals from 24 months to 47 months; but the sharpest acceleration appears from 24 to 41 months. In Table 4, it appears that there is a marked increase in verbosity and vocabulary with mental age from 27 months to 59 months, with

TABLE 3

DEVELOPMENT OF VERBOSITY AND VOCABULARY AS RELATED TO MENTAL AGE

Mean and median number of words spoken and different words used per three hours by 88 two- to five-year-old children, ranging from 27 to 86 months in mental age.

Mental Age in Months	No. of Children	No. of Words Spoken (T)			No. of Different Words Used, (D)		
		Range	Mean	Median	Range	Mean	Median
Tri-monthly							
27-29	3	202-299	248	243	51-105	72	60
30-32	4	99-512	334	362	36-112	75	77
33-35	3	236-434	304	241	70- 82	76	75
36=38	8	312-1282	620	483	57-195	115	116
39-41	3	715-1620	1236	1370	155-273	236	247
42-44	7	212-1780	880	979	88-284	105	189
45-47	11	332-1605	707	682	117-264	167	171
48-50	4	831-1584	1024	951	164-273	209	200
51-53	8	793-2588	1461	1472	194-298	247	250
54-56	8	322-2162	1444	1463	102-344	288	283
57-59	8	1436-3084	2066	1853	273-533	365	318
60-62	6	1316-2212	1842	2042	204-304	328	239
63-65	4	396-2289	1300	1257	111-385	254	260
66-68	3	1038-1843	1620	1679	210-349	282	286
69-71	2	599-1370	906	985	107-262	185	185
72-74	2	1384-2664	2024	2024	285-376	331	331
75-77	1	-	1737	-	-	329	-
78-80	0	-	-	-	-	-	-
81-83	2	714-1878	1346	1340	164-359	262	262
84-86	1	-	1426	-	-	337	-
Half-yearly							
24-29	3	202-229	248	243	51-105	72	60
30-35	7	99-512	321	199	36-112	75	75
36-41	11	312-1620	788	715	57-273	148	132
42-47	18	212-1780	862	646	88-284	174	172
48-53	12	613-2606	1316	1247	164-298	234	236
54-59	16	322-3004	1765	1713	102-552	312	295
60-65	10	396-2288	1625	1603	111-394	290	319
66-71	5	599-1843	1308	1370	107-349	243	262
72-77	3	1384-2664	1928	1737	205-376	330	329
78-83	2	714-1979	1346	1346	164-359	262	262
84-86	1	-	1426	-	-	337	-
Yearly							
24-35	10	99-512	299	271	36-112	74	75
36-47	29	212-1780	834	729	57-284	164	168
48-59	20	322-3084	1566	1483	102-552	279	274
60-71	15	396-2289	1519	1375	107-394	280	288
72-83	5	714-2664	1695	1737	164-376	303	329

the sharpest rise occurring at the mental age range from 36 to 53 months. The fact that there is little or no increase in the upper age levels, within the present narrow range (after the fourth year of chronological age, and after the fifth year of mental age) is due, in part, to the fact that some of the older children were enrolled in kindergartens, but the results show a deceleration in *the rate of increase even when these children are left out of the computations* (See Table 6). The trend would be more impressive if the subjects included a larger number of older children. However, various minor indications in the tables (the range of individual scores and the medians at tri-monthly and half-yearly age levels) are quite consistent with the trends noted above, and limited as internal evidence of this kind may be, it suggests that the trends might be confirmed if a larger number of older subjects had been studied. Even if this is granted, however, there remains the question as to what these trends mean. The slowing of the rate of language development in the older children may not reflect a "true" developmental phenomenon so much as it reflects specific environmental influences. It is possible that the nursery school environment is relatively more stimulating to the younger than to the older children, and (although adequate proof is lacking) that the deceleration shown by the older children would not be nearly so marked if the school environment were relatively as stimulating to the older as to the younger child.[9]

COMPARISONS BETWEEN SELECTED GROUPS

In an attempt to isolate, as far as possible, the factor of age in relation to language development, separate tabulations were made of the data of forty-four selected children, by way of a supplement to the tabulations based on all the subjects. An effort was made to select comparable groups of children at half-yearly age levels. The eleven children available at the 24-29 level were

TABLE 4

DISTRIBUTION OF AGE, SEX, AND I.Q. OF SELECTED GROUPS OF SUBJECTS

Age in Months	N	Boys	Girls	Ave. C.A.	Ave. I.Q.	No. of 3-hour records available per child	
						3 hr.	2 hr.
24-29	11	3	8	26.8	129.7 (12.9)*	10	1
30-35	11	6	5	32.5	133.4 (7.8)	10	1
36-41	11	4	7	38.6	130.9 (10.7)	10	1
42-47	11	5	6	44.6	131.9 (10.7)	10	1

*The values in parentnesis represent average deviations.

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[9] It is obvious that tallies simply of number of words spoken and number of different words used measure only limited aspects of language development. However, certain other indices tended to conform to the pattern noted above. An independent tabulation of the use of the past tense likewise indicated a tendency toward less rapid progress among the older children of nursery school age. There was a sharp increase in the use of the past tense at half-yearly levels from 24-29 months to 36-41 months, but children aged 42-47 months scored no higher than did children in the 36-41 months range.

used as a starting point. Groups of eleven children at succeeding half-yearly levels were chosen to resemble each other, as nearly as could be approximated, along the following lines: an average age corresponding to the mid-point of the interval which each group represents and a similar distribution of ages around that mid-point in the various groups; similarity in average I.Q. and in spread of I.Q. scores; similarity in number of boys and girls; similarity in number of language records available per child. These conditions were met as nearly as possible, but a perfect match could not, of course, be obtained. The greatest dissimilarity between the groups occurs in the number of boys and girls, but rather than sacrifice subjects, this shortcoming was allowed. Due to the small number of subjects above the age of four years, the "matched" subjects were limited to four groups of two- and three-year-old children. These groups are described in Table 4. Within each group, records covering three days were available for ten children, while records for two days were available for the eleventh child.

The records of these selected groups are summarized in Table 5. From the point of view of total amount of language spoken per unit of time, it appears from Table 5 that:

There is somewhat more than a four-fold increase in number of words spoken during the age interval from the first half of the second year to the *last half of the third year (or, in terms of averages as indicated in Table 4,* from the 27th to the 45th month). Somewhat more than a four-fold increase during this interval is also shown for the larger groups of "unmatched" children represented in Table 2. In terms of yearly averages, three-year-olds show approximately a three-fold increase over two-year-olds.

According to Table 5, the biggest spurt in amount of talking and in size of active vocabulary comes during the interval from 36 to 41 months (inclusive). This trend is not consistently confirmed, however, by the results based on all subjects (Table 2). Both Tables 4 and 2 show that the rate of increase in amount of talking is considerably more rapid up to the age of three and a half years than during the ensuing half year (comparisons with later half-yearly levels are not legitimate by reason of the fact that two of the older children were below the group-average in intelligence, and the further fact that some of them attended kindergarten.

The age trends in Table 2 and 5 are complicated by the fact that there is a larger proportion of girls at the younger levels. It has been found in earlier studies, and also in the present study (see a later section of this report) that girls somewhat excel boys in early language development. The age trends here noted are, however, somewhat too marked to be explained solely on the basis of sex differences.

On the basis of results obtained for all subjects within the age range from 24 to 48 months, the average increase in amount of talking at each half-yearly age level as compared with the preceding half-year was 66 per cent. The corresponding average half-yearly increase in number of different words used was 60 per cent. On the basis of the records of a smaller number of subjects in the age range from 24 to 48 months, as represented in Table 5, the average increase in number of words spoken at a given half-yearly level as compared with the preceding half-year was 68 per cent; and the corresponding average increase in number of different words used was 57 per cent. The increase at half-yearly levels is, however, decidedly larger (ranging from two- to seven-fold larger in the various comparisons) at the 30-35 months interval and at the 36-41 months interval (as compared with the respective preceding half-year levels) than at the 42-47 months interval. On the basis of the present results, there is a distinct deceleration in the language gains of bright children in the nursery school situation at the age of three and a half years. The falling off in the gains at this point is larger than would be accounted for by the relative proportions of boys and girls at the various half-yearly levels.

TABLE 5

DEVELOPMENT OF VERBOSITY AND VOCABULARY AS RELATED TO CHRONOLOGICAL AGE

(1) Number of words spoken, (2) number of different words used, and ratio of (2) to (1) in data of "matched" groups of children at various age levels[(a)]

		Per 3-Hour Period									Per 6–9 Hours		
		T: No. words spoken			D: No. different words used			R: Ratio D/T (c)			R		
	N	Mean	SD(d)	Diff. / σ Diff. (f)	Mean	S.D.	Diff. / σ Diff.	Mean	S.D.	Diff. / σ Diff.	Mean	S.D.	Diff. / σ Diff.
Half-yearly													
24–29	11	407	208	-	94	41	-	.261	.098	-	.176	.067	-
30–35	11	688	384	2.42	137	70	2.23	.220	.088	1.64	.150	.071	1.33
36–41	11	1457	644	4.04	257	94	4.96	.197	.079	.86	.119	.048	1.38
42–47	11	2011	892	2.09	340	147	2.19	.186	.078	.45	.104	.035	1.47
Yearly													
24–35	22	547	309	-	116	54	-	.241	.076	-	.163	.058	-
36–47	22	1734	710	7.02	298	109	6.90	.191	.064	2.27	.111	.033	3.52

		T.			D.			R.			R.		
		Median	Q	Diff. / P.E.Diff.	Median	Q	Diff. / P.E.Diff.	Median	Q	Diff. / P.E.Diff.	Median	Q	Diff. / P.E.Diff.
Half-yearly													
24–29	11	424	131	-	81	25	-	.252	.082	-	.169	.029	-
30–35	11	646	190	2.21	149	45	4.14	.212	.021	2.31	.130	.032	1.95
36–41	11	1478	380	5.18	264	27	5.62	.177	.035	1.56	.120	.021	.50
42–47	11	1843	644	1.63	292	54	.88	.176	.020	.05	.107	.008	1.30
Yearly													
24–35	22	499	218	-	108	41	-	.230	.030	-	.150	.033	-
36–47	22	1586	331	7.61	280	31	7.67	.177	.021	2.90	.109	.015	3.33

(a) See Table 4 for description of subjects.
(b) Represents three 3-hour records in the case of 10 children at each half-yearly interval and two three-hour records in the eleventh case.
(c) Mean (and median) ratios are based upon averages, separately computed for each child.
(d) Represents a tally of one only for a given word in a child's data, whether the word occurred once or several times in one or more of the child's records.
(e) S.D.'s were computed on the basis of a denominator of N-1. The number of cases is obviously too small to yield valid S.D.'s, but these are reported, none the less, for what they may be worth.
(f) In computing the value of $\Delta/\sigma\Delta$ (and $\Delta/P.E._{\Delta}$) in each half-yearly comparison, the correlation between the scores of children in constituent "matched" groups was taken into account, statistically. The coefficients in question were all positive and ranged from .35 to .77, with a median of .50. In comparisons between yearly age levels, these correlations were not taken into account.

INCREASE IN VOCABULARY AS COMPARED WITH INCREASE IN VERBOSITY

From the point of view of number of different words used, or size of active vocabulary within the periods covered by the study, the results in Table 5 indicate that:

The increase in active vocabulary from the first half of the second year to the second half of the third year (or, in terms of average ages according to Table 3, from 26.8 months to 44.6 months) is somewhat above three-fold.

The three-fold gain during this period in number of different words used is uniformly lower than the four- to five-fold gain exhibited in total number of words spoken. In other words, there is a larger gain with age in verbosity than in size of vocabulary. This trend also appears at the separate half-yearly age levels from two to four years, both in the unselected and the "matched" groups.

The relation just noted between verbosity and size of vocabulary is shown more precisely in the D/T ratios in Table 6. At the 24-29 months level, for example, the ratio of number of different words used (D) to total number of words spoken (T) per three hours is .261. This means, roughly, that every fourth word is a "new" word, or (again, very roughly) that each word that is used is repeated, on the average, four times. At the 41-47 months level, the ratio falls to .186, which, on the same basis, means that the vocabulary used by the average child during three hours is about one-fifth as large as the volume of words spoken.[10]

The tendency of younger children to use single-word sentences, might, in some respects, tend to increase the ratio, but, on the other hand, the younger child's tendency to repeat single words and phrases would operate in the other direction.

The tendency of younger children to use a higher proportion of different words in relation to total number of words spoken appears again in the results for two or three mornings combined. At the 24-29 months level, for example, the average number of different words used per morning represented 45 per cent of the words used by the child during all mornings combined. At this age, the children spoke 94 words per three hours, on the average; the average per child during six to nine hours was 105. At the 41-47 months level, the corresponding percentage is 58. The difference here is not large, but the trend is consistent from one half-yearly age level to the next. The findings here suggest that an older child gives a more representative sampling of the size of his vocabulary within a three-hour period than does a younger child (within the age range, sampling, and environment of the present study).

Representativeness of One Day's Sampling as Related to Age. This tendency also appears when the data are examined in terms of daily records. In the case of the children in the "matched" groups, a count was made of the different words used by each child during the first day of observation, of the "new" words added on the second day which were not spoken on the first day, and of the words used on the third day which were not used either on the first or second days. Following is a summary of the results. The values represent percentages, based upon the total number of different words used during three days. The denominator in computing the percentages is the number of different words spoken during the total period of three days.

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[10] Lists showing the frequency of various words were examined to discover whether certain word forms that inevitably occur frequently during conversation were having a differential effect on the ratios at different age levels. The words spoken most frequently in all groups we various forms of the first personal pronoun, and various forms of the verb "to be." Moreover, "you" showed increasing frequency with age. But when the tally of these forms was subtracted from the total, the differences between the ratios at different age levels were substantially unchanged.

Age in Months	24-29	30-35	36-41	42-47	All
N*	10	11	11	10	42**
Per cent of words appearing in the first day's records	48	52	60	67	53.8
Per cent of "new" words added the second day	27.5	20	25	24	25.6
Per cent of "new" words added the third day	24.5	22	17	19	20.6

A single day of observation (as compared with three days) reflects relatively a somewhat larger representation of the active vocabulary of older children than of younger children.

The ratios set forth above for all subjects combined, regardless of age differences, are of some interest. It appears that a single three-hour record per child in the age range under consideration will yield about half as many different words as will be found at the end of three three-hour records.

CORRELATIONS WITH AGE AND INTELLIGENCE

When the language scores of the 88 children were correlated with mental age, chronological age, and I.Q., the following coefficients were obtained:***

	No. of words spoken	No. of different words used
Chronological age	.58	.63
Mental age	.59	.67
I.Q.	.23	.30

These coefficients give practically equal weight to the factors of chronological and mental age with a slight indication that there is a higher relationship between intelligence and the size of a child's vocabulary than between intelligence and a child's verbosity. The results in Tables 3 and 4 suggest, however, that the factor of mental age may be more important, relatively, at the younger than at the older age levels. This is borne out also when correlations are computed between mental age and language scores at separate six-months (chronological) intervals. The correlation between mental age and total number of words spoken at the chronological range from 22 to 29 months is .70; corresponding coefficients at succeeding intervals (30-35 months, 36-41, and 42-47) are, respectively, .50, .09 and .24. (These coefficients represent the following number of children: 12, 20, 22, and 26.) The correlations between mental age and number of different words used at the corresponding intervals are: .61, .63, .26, and .42.

In spite of the irregularities exhibited by these coefficients, they definitely suggest that there is a closer relationship between mental age and language development in the case of the younger than in the case of the older children.

The same trend appears when correlations between I.Q. and language scores are computed at successive half-yearly age levels. The correlation between I.Q. and number of words spoken at 22 to 29 months is .67; at 30-

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*The summary omits children for whom there were only two three-hour records. In two of the groups, three records were available for all the children. In earlier tables, the record for the third day of one child in each of these groups was discarded to provide a similar number of records in each of the "matched" groups.

**Rough computations indicate that substantially the same values would emerge if the records of all 88 children in the study were analyzed.

***The correlation between number of words spoken per three hours and number of different words used (on the basis of results for all 88 children), with the factor of age held constant, was .56.

TABLE 6

COMPARISONS BETWEEN BOYS AND GIRLS IN VERBOSITY AND VOCABULARY AS RELATED TO CHRONOLOGICAL AGE[(a)]

Age in Months	No. of Children		No. of Words Spoken Per 3 Hours (T)						No. of Different Words Used Per 3 Hours (D)						Ratio: D/T					
			Range		Mean		Median		Range		Mean		Median		Range		Mean		Median	
	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls
Trimonthly																				
24-26[(b)]	1	3	-	241-434	243	363	243	424	-	70-112	60	85	60	75	-	.243-.297	.247	.278	.247	.293
27-29	2	5	299-727	236-622	514	421	514	431	75-142	81-132	109	100	109	82	.203-.252	.200-.353	.228	.258	.228	.259
30-32	6	5	99-1370	212-1029	751	680	747	682	36-275	88-211	128	151	105	175	.136-.359	.212-.413	.209	.257	.189	.254
33-35	5	4	299-1370	494-1967	741	980	753	746	105-218	104-293	166	173	171	146	.218-.352	.143-.201	.253	.209	.231	.225
36-38	6	5	849-1620	793-1605	1292	1174	1024	1008	184-247	137-275	207	229	194	258	.155-.238	.165-.238	.199	.213	.196	.195
39-41	4	7	396-1478	1139-1990	889	1619	842	1470	111-240	219-394	183	230	200	284	.162-.300	.143-.301	.255	.185	.276	.193
42-44	5	7	631-2093	332-2723	1372	1622	1436	1567	164-343	117-552	258	303	276	288	.170-.307	.159-.400	.222	.214	.219	.181
45-47	8	6	1370-2596	1375-3094	1830	2137	1750	2066	255-381	213-500	307	364	304	363	.102-.307	.164-.230	.172	.188	.178	.183
48-50	2	1	322-1865	-	1094	1905	1094	1905	102-344	-	223	279	223	273	.164-.316	-	.252	.195	.250	.195
51-53	1	1	-	-	714	1384	714	1384	-	-	164	285	164	285	-	-	.246	.209	.246	.209
Half-yearly																				
24-29[(c)]	3	8	243-729	236-622	424	399	299	428	60-142	70-132	93	94	75	82	.203-.252	.200-.252	.234	.272	.247	.252
30-35	11	9	99-1370	212-1957	746	784	753	682	36-273	88-298	145	161	149	173	.136-.359	.148-.418	.229	.241	.226	.234
36-41	10	12	396-1620	793-1990	1031	1434	970	1468	111-247	137-334	199	265	194	265	.155-.300	.148-.288	.221	.197	.217	.191
42-47	13	13	631-2586	332-3034	1684	1860	1679	1843	164-391	117-552	208	331	292	321	.102-.307	.159-.400	.191	.202	.184	.181
48-53[(d)]	3	2	322-1865	1334-1905	967	1645	714	1645	102-344	275-285	203	232	164	232	.184-.316	.195-.209	.249	.202	.246	.202
Yearly[(d)]																				
24-35	14	17	99-1370	212-1967	677[(e)]	603	688	494	36-273	70-298	134	129	137	112	.136-.359	.148-.418	.250	.256	.228	.243
36-47	23	25	396-2596	332-3084	1401	1655	1435	1564	111-391	117-552	249	299	247	284	.102-.307	.148-.400	.204	.199	.199	.184
48-59[(e)]	4	5	322-1978	1334-1905	1220	1572	1290	1426	102-359	279-337	242	300	254	285	.183-.310	.195-.256	.232	.213	.216[(f)]	.209

(a) The means and medians are computed on the basis described in connection with Table 2.

(b) Age levels in which only one sex is represented are omitted from the table.

(c) Note that the values for girls at the yearly level of 24 to 35 months are distorted by the disproportionately large number of girls at the half-yearly level of 24 to 29 months.

(d) Average IQ's at yearly age levels, of boys and girls as shown in Table 1 respectively, follow: 2 years, 123 and 137; three years, 130 and 136; four years, 132 and 138. Average IQ's at smaller age intervals are shown in Table 1.

(e) The 48-59 level includes one girl within the range 54-56, and one boy within the range 57-59, who are omitted from the half-yearly comparisons. Δ/σd values, for average number of words spoken and number of different words used are, respectively, .44 and .15 in favor of the boys at two years and 1.26 and 1.67 in favor of the girls at three years.

(f) The average ratio of all boys combined (including two not represented in the table) is .216; all girls, .222: corresponding medians are .203 and .201.

35 months, .46; at 36-41, .13; at 42-47, .19. The corresponding, respective correlations between I.Q. and number of different words used is .56, .57, .22, and .32. (At 48 to 62 months, representing only 8 subjects, the coefficients are .26 and .40.)

The foregoing points to a consistent positive correlation between I.Q. and language development (and this in spite of the fact that the range of I.Q. is limited, with no score below 100) as measured by the present indices, but it appears that the correlation is higher before the age of three years than it is thereafter.

COMPARISONS BETWEEN BOYS AND GIRLS

In several studies, girls have appeared to have an advantage over boys in early language development. By reason of the attention which this topic has received, the present data were also tabulated from the point of view of comparisons between the sexes. Table 6 shows these comparisons, based upon all the subjects in the study, representing 41 boys and 45 girls. The scores for total number of words spoken and total number of different words used are computed in terms of averages per three hours.

According to the results in Table 6, girls excel boys in number of words spoken and number of different words used in most of the comparisons at half-yearly age levels. In the case of ratio of total number of words spoken to number of different words used, the differences are not consistent or large.

The comparisons in Table 6, it will be observed, are based upon uneven numbers, without regard to differences in the ages and I.Q.'s of the boys and girls in the various groups. In order to eliminate these differences, as far as possible, another series of comparisons was made, based only upon an equal number of boys and girls, matched with respect to C.A., M.A. and I.Q. The table showing these comparisons, representing 34 pairs, including 9, 22, and 3 pairs respectively at two, three and four years, is not reproduced here, since it showed substantially the same trends as are revealed in Table 6: boys again surpassed girls at the two-year level, girls surpassed boys at the three- and four-year levels, and in the results for all ages combined. In the combined records, the boys showed an average of 1306 words spoken, as compared with 1379 for the girls; according to statistical computation, the chances are only 47 in a hundred that there is a true difference. The respective averages for the number of different words used were 235 and 260, again favoring the girls; the chances of a true difference were 76 in a hundred. Sex differences in the verbosity-vocabulary ratios in this restricted group were not consistent with those shown in Table 6; boys showed a higher ratio at three and four years, girls at two years, manifesting a trend that is neither substantial nor statistically reliable.

In summary, then, the present findings with regard to sex differences in verbosity and vocabulary indicate that girls tend quite consistently to surpass the boys, but not to a degree that is statistically significant. In the matter of size of active vocabulary in relation to loquacity, there are no conspicuous or reliable differences.

ILLUSTRATIVE RECORDS OF INDIVIDUAL CHILDREN

The foregoing tables indicate that there are large individual differences among children, merely from the quantitative point of view. The differences exhibited simply in terms of amount of language spoken and number of different words used are no more impressive than the differences which appear

Charles. Age 23 months. (Youngest in group)

TIME	PLACE	SITUATION	CHILD'S LANGUAGE
9:10	Roof	Sees Mary White	Mary White
		Goes to slide and slides. Goes up again and slides. Jimmy is crying. C. goes over to him and watches. T (teacher) comes over for C. to give him his orange juice.	No. No.
		Runs back to slide. T. comes over and takes his hand.	No, no.
		Goes to slide and sits on top. Looks at D. who is swinging.	Hello, Dickie. Hello, Dickie. (Too low for D. to hear.)
		Slides. Then goes over to James and Jack, who are on the engine. Watches them, then returns to slide. Slides. Goes up again. Mabel goes by with truck.	Hello, Mabel. Hello, Mabel.
		He slides. Runs to wooden horse. Climbs up. Looks at children.	Hello, Mary, hello, Mabel.
		Returns to slide and slides. Goes up again and slides. Goes up again. Mabel, on swing, says, "Bobby Burr-Bobby Burr."	Bobby Burr. Bobby Burr. Bobby Burr.
9:25		Slides. Goes up again. T: Charles, let's go get our orange juice.	

Henry. Age 58 months.
(Note that this excerpt covers only 9 minutes, while the above represents 15 minutes).

TIME	PLACE	SITUATION	CHILD'S LANGUAGE
9:05	Roof	Henry and Jerome go to large group of boxes. Henry gets up into large box. Billy gets into box with him.	No, no, Billy. This isn't for you. Jerome, here's Billy.
		Jerome: No, you cannot.	
		T: gives Jerome rope.	Oh, thank you very much. Give it to the captain. Throw it up to the captain. I'll do it for you. You will make a big knot. Give it to me.
		Jerome gives him the rope. T. takes small boxes down from top of box.	Don't take the big box down, will you?
		T: You see, there are so many up here and they are so high up they might hurt the children.	
		Jerome gets rope. Let's tie it.	You get off here and I'll tie it.
		Jerome: What?	You get off here and I'll tie that.
		Jerome: You tie the galloping ponies.	
		They climb down from box.	Here, pony. Come here, pony. Come over here. Where our barn is going to be. Come where I'm going. Come over here.
		G. steps on rope accidentally	Hey, you. Stop that.
		They run to jungle gym.	
		Jerome: What are you going to do?	I'm going to tie it on to your cage.
		Jerome: Why?	Because I don't want you to walk away. Come here, horsie.
		Jerome: No, sir. I'm going to run away.	
9:12		Jerome runs away.	John, will you hold this rope while I catch Jerome?
		John holds rope and Henry runs after Jerome.	Hey, John, catch Jerome. I'm going to catch him in the rope. I'm going to catch him in the rope.
		He goes back to John.	John, you be the pony.
		John: Yes.	
		Henry puts rope around John. Jerome comes over.	You are not playing. John is going to be the pony, so don't you care. You aren't going to play. Now the pony can't get any further away.
		He ties rope to jungle gym. The knot slips and John runs away.	Pony. (Laughs.)
		Henry ties it again.	I'm going to do it another way now.
		Bell: What are you doing?	I'm going to tie John in here.
		Bell: Why?	Because he's my pony. I don't want him to run away.
		Bell: Why don't you want him to run away?	Because I don't want him to get lost again.
		Bell: Well, I'll tie a very hard knot then he can't get away.	
		John goes away and Jerome comes over. Jerome: Henry, you tie Bell. Tie Bell.	All right. Where will we tie him? I'll tie it over here.
9:14		Takes rope to box John is playing in.	Hey, John. Don't do that. What do you mean by doing that? Johnny, are you making another boat like you made yesterday?

The two ten-minute excerpts which follow offer a comparison between two of the youngest children (both 24 months old) of similar I.Q., who differ considerably in total number of words spoken.

Meg. Age 24 months. I.Q. 139

Average number of words spoken per three hours: 434.

TIME	PLACE	SITUATION	CHILD'S LANGUAGE
9:50		She goes to swing.	I want to swing too. I want to swing too. I want to swing too. I want to swing.
		She gets on swing and swings.	Swing. Swing. Swing.
9:53		She leaves swing. Takes carriage away from Frances.	I want to take the carriage. I want to take the carriage.
		She wheels it into the cupboard.	I want to put the doll and carriage away. I want to put the doll and carriage away.
		Helen has teddy-bear in cupboard.	Hush-a-bye morning. Carriage is moving. Carriage is crooked. I put the carriage away.
		Helen closes cupboard doors. Meg laughs.	I want to see something. Leave the doors open. Leave the doors open.
		They open the doors. Helen takes the carriage.	Leave it in.
		Helen: No, no. (She takes it out.)	
9:55		Max comes out and looks around.	Choo choo train. Choo choo train. Choo choo.
9:57		She goes to other side of roof. Jim is there. She looks at him.	Jim.
9:58		He pushes her away.	
		She watches children there. Returns to other side. Goes to swing.	I want to swing on that swing. I want the doll-swing. I want the doll swing. I want the doll swing.
		She swings.	Swing. I got a swing. I got a swing. Swing. Swing.
10:00		She leaves swing. Gets wheelbarrow and pushes it around. Goes to elevator. T. is there with group of children.	I want to go in. I want to go in.

Rachel. Age 24 months. I.Q. 139

Average words spoken per three hours, 241

TIME	PLACE	SITUATION	CHILD'S LANGUAGE
9:22		Comes in and is examined.	
9:24		Looks at T.	My jacket?
		T: What is it?	My jacket?
		T: We are going to take it off.	
		She takes her mittens off.	My mittens. My mittens. My jacket? My jacket?
		She unzips it. T: You can take it off, can't you? We will take off your hat.	My hat.
		She points to T's pin.	What is this? What is this? What's this?
		T. talks to someone, does not answer her. T. takes her things off and she walks away.	
		T: Rachel, you put your galoshes away.	What?
		T: You put your galoshes away. She picks up her galoshes. Takes them to her locker, finds rubbers there that do not belong to her.	Rubbers. Rubbers.
		T: Don't they belong to you? Put your galoshes in there.	My galoshes.
		She puts her galoshes in her locker.	
9:32	Play-room	She gets carriage. Wheels it around. T. takes her to bathroom. She goes to toilet. Points to T's beads.	What's this?
		T: Beads. Do you like beads? T picks up Rachel's dress.	My dress.
		T: That's a very pretty dress.	My dress.
		T: Yes, Rachel's pretty dress.	

when the language records are studied in terms of the style and content of the language of different children. By way of illustrating some of the differences, representative portions of the records of different children are reproduced below.

The two excerpts, on the preceding page, give a comparison between the youngest and one of the oldest children in the study. The contrast is marked, not only from the point of view of quantity of language per unit of time, but also from the point of view of the content and complexity of the language pattern.

SUMMARY AND DISCUSSION

This study deals with the development of loquacity and vocabulary in the language of preschool children of high average intelligence. The subjects were 88 two- to five-year-old children, enrolled in nursery schools and kindergartens. The average IQ of the subjects was 132.

The data consist of stenographic, verbatim records of the children's language during the school day from the time when the children arrived in the morning until the time for the afternoon nap. Each child's language was recorded during two or three days. Seventy-three of the children were observed during three days, or about nine hours, and the remaining fifteen were observed during two days, or about six hours, representing a total of 249 separate, daily records for all subjects combined.

The main treatment of the data for the purposes of the present study consisted of a tally of the total number of words spoken (loquacity) and the number of different words used (vocabulary) by each child. Correlations between children's scores on separate days gave reliability coefficients ranging above .70.

As might be expected, the results show a substantial increase with chronological and mental age in amount of talking and in size of vocabulary. When the factor of IQ is taken into consideration, the results, when treated according to chronological age levels, agree substantially with the results according to mental age.

The gain at each half-yearly level as compared with the preceding half-year in the age range from 24 to 48 months was approximately 66 per cent in number of words spoken and 50 per cent in number of different words used. The gains were decidedly larger at half-yearly intervals from 24 to 41 months than at the succeeding half-year (in various comparisons, the former gains range from 50 to 129 per cent, the latter from 11 to 37 per cent). According to the present results, there is a distinct deceleration in the language gains, as measured by the present methods, of bright children in the nursery school situation at the age of three and a half years. The present data do not indicate to what extent that is a normal developmental trend and to what extent it may be due to various environmental factors.

The increase with age in amount of talking is larger than the increase in the vocabulary used while talking. Children aged 42-47 months spoke between four and five times as much per three hours as did children aged 24-29 months, but they used only a little more than three times as many different words as did the younger children.

Corresponding to the foregoing, there was a decline with age in the ratio of amount of talking to size of vocabulary used. At 24-29 months, the ratio of number of different words used to number of words spoken per three hours (including repetitions of the same word) was approximately four to one; at 42-47 months the ratio was about five to one. Roughly speaking, each fourth word spoken at 24-29 months was a "new" word, while at 42-47 months only every fifth word was "new." This trend appeared in spite of the greater tendency of younger children to repeat single words many times in succession. (These results were not materially altered when certain words that frequently recur in conversation at all age levels, such as various forms of the verb *to be* and of the first personal pronoun, were eliminated from the computations.)

The results further show, in keeping with the foregoing, that a given time sampling of the spontaneous talk of a younger child in the free nursery school situation will be less representative of the child's vocabulary than will a sampling of similar duration in the case of an older child. This appeared from a tabulation of all the different words appearing in the records during three days in the case of each of ten selected children at the four half-yearly age levels from 24 to 47 months. At 24-29 months, 48 per cent of the child's three-day vocabulary appeared the first day; 27.5 per cent of the words were added the second day, and 24.5 per cent the third day. At later half-yearly levels, a larger percentage of the child's three-day vocabulary appeared in the first day's record (57 per cent at 42-47 months) and, correspondingly, each new day brought relatively fewer "new" words into the record (24 and 19 per cent, respectively, on the second and third day in the case of children aged 42-47 months). The differences between successive half-yearly levels are not large, but their general trend is noteworthy.

In a majority of comparisons at half-yearly age levels, the girls surpassed the boys both in loquacity and in vocabulary. Comparisons between boys and girls matched with respect to age and IQ likewise showed the girls to be in the lead, but the differences were not statistically reliable. In the matter of the ratio of size of vocabulary to total amount of talking, the sexes were substantially similar.

The correlation between chronological age and number of words spoken per three hours was .58; between C.A. and number of different words used, .63, The corresponding correlations with mental age were .59 and .67; and with I.Q. .23 and .30.

The correlations with I.Q. may be considered relatively high in view of the fact that all children were above average in intelligence. Judging from these coefficients, and the trends in the language scores as related to mental age, considerably higher coefficients might be expected if measurements were made of a more representative sampling of the child population at large.

The results indicate that there is a considerably higher relationship between language development (as here measured) and I.Q. (as measured by standard tests) among younger than among older children within the nursery school range. The correlation between mental age and number of words spoken by children aged (chronologically) 24-29 months was .70; at succeeding half-yearly levels the corresponding respective coefficients were .50, .09, and .24. In the case of number of different words used, the correlations with mental age were likewise higher at two years than at three (the respective half-yearly coefficients from 24 to 48 months were .61, .63, .26, and .42). Similarly, the younger children showed a considerably higher correlation between I.Q. and language scores than did the older ones: the correlation between I.Q. and number of words used was .67 at 24-29 months; .46 at 30-35 months; .13 at 42-47 months; and .26 at 48-62 months (representing only 8 subjects). The corresponding coefficients in the case of number of different words used were .56, .57, .22, .32, and .40.

The findings with regard to a higher relationship between intelligence and language development in the case of the younger than in the case of the older children of nursery school age are open to several interpretations. At first glance, it appears that the effects of intelligence are more prominent during the period when language is still rapidly in the process of being established as a means of social intercourse between children than during later periods of refinement and expansion. On the other hand, the relationship may not represent a true developmental phenomenon but may be merely an artifact; it may be that facility in the understanding and use of language is relatively more helpful in earning a high score on mental tests for younger than for older children. Again, even if this reservation is waived, it is possible that the trends would be different if aspects of language other than simply the volume of speech and size of vocabulary were treated. Further, the trends may be a function of the conditions under which the data were obtained: it is possible that the findings would be different if the children had been studied during their entire day, rather than only during their stay in nursery school, or if the data had dealt not simply with spontaneous speech but with language precipitated by questioning and conversation under experimental conditions. Further research is needed to answer these questions.

It can be seen that some of the results reviewed above have certain practical implications. From a research point of view, it would appear that some practical significance attaches to the fact that a three-hour sampling of the active vocabulary of children during their free play is relatively more adequate, as compared with a nine-hour sampling, in the case of the younger than in the case of older children within the nursery school range. Stated differently, a larger proportion of "new" data accrued from each added three-hour period of observation (within the same week, or, in the most extreme instances, within the same month) in the case of younger than in the case of older children. The present results are in keeping with findings in other studies, particularly in the area of mental measurement, which indicate that it usually is more time-consuming and difficult to obtain reliable measurements of younger than of older children.

Moreover, according to the present results, it is conceivable that the scores obtained in different samplings may be low and yet show a consistent distribution, thereby yielding a high reliability coefficient, in the usual statistical sense, and still fail to tap underlying abilities or characteristics in the case of younger children as adequately as do higher scores, in a similar time sampling, in the case of older children.

Two of the findings, namely, that there is a distinct decline in the rate of language gains at about three and half years, and that scores show a higher correlation with IQ and mental age in the case of younger than in the case of older children, suggest certain educational implications. To be sure, these trends may be due to a variety of factors, but they do suggest, among other things, that the conventional nursery school situation may be relatively more stimulating, and relatively more of a challenge, to younger than to older bright children within the customary nursery school age range. Further study would be needed to show whether this hypothesis is correct. Even if it were proved to be correct, there would still be the question as to whether anything should be done about it. In addition, it should be emphasized that the subjects who display this trend are above average in intelligence. Even with these reservations, however, the findings are not without significance from a practical point of view, especially when considered in conjunction with somewhat similar trends that are emerging from studies of other aspects of the development of nursery school children. Preliminary results in a study by Gutteridge,[11] dealing with the motor activities of preschool children, indicate that the conventional nursery school environment is relatively less stimulating, in the motor sphere, to younger than to older pupils. The findings indicate that a large proportion of children will have gained substantial mastery of the skills involved in the use of several of the standard items of equipment long before the end of their stay in the conventional nursery school. These findings suggest the need for a revision and

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[11] Gutteridge, Mary. The development of motor skill in preschool children. (Tentative title) Unpublished. 1938. Teachers College, Columbia University.

ERRATA

Attention is called to two errors in wording in the paper entitled "Aspects of language development: The growth of loquacity and vocabulary," by A. T. Jersild and Ruth Ritzman, which appeared in CHILD DEVELOPMENT, Vol. 9, No. 3, September 1938:

Page 258 - 16th line from the top should read: "active vocabulary of children during their free play is relatively less adequate,..."

Page 258 - 5th line from the bottom should read: "school environment is relatively more stimulating, in the motor sphere, to younger..."

extension of the motor aspects of the curriculum for older nursery school children, just as the present findings tentatively suggest that intellectual aspects of the curriculum might profitably be revised and augmented in order to give the child an optimum opportunity to enjoy the use of his growing powers. Obviously, the findings underlying this suggestion need to be confirmed and need to be supplemented by research that will yield concrete recommendations.

SOME RELATIONSHIPS BETWEEN MUSCULAR PROCESSES AND PERSONALITY AND THEIR FACTORIAL ANALYSIS

M. A. WENGER[1]

A popular topic for psychological discussion, but a relatively unexplored field of research, has been the often suggested relationship between muscular processes and temperament. Since temperament is so generally regarded as a component of personality, the latter term is most frequently employed as the postulated correlate. Many years ago James (11) spoke of the "explosive" and "obstructed" types of personality, of which the former was supposedly associated with hyperactivity of the skeletal musculature and the later with hypoactivity. Later Davenport (3) wrote of hyperkinesis and hypokinesis and certain apparent relationships to temperament. Downey (4) also assumed similar relationships and attempted to measure individual differences in motor activities. In addition to these observations by psychologists it is almost commonplace in lay thought to relate differences in personality to individual differences in muscular activity, muscular tension, or neuro-muscular energy. Witness such descriptive terms as "bundle of nerves", "restless", "jittery", "fidgety", "jumpy", "nervous", "tense", and "energetic", which are used not only to describe personalities but which are commonly related among themselves and to other manifestations of personal-social behavior differences. Not the most uncommon relative, but perhaps the most obscure, is emotional tension.

The experimental literature bearing directly upon the problem is not large. In 1928 Johnson (12) cited data suggesting a relationship between overt muscular tension and individual differences in temperament. Duffy (5, 6), following her work, found that for a group of nursery-school children tension upon a hand dynamometer during a task correlated 0.52 with ratings of excitability made by teachers and physicians. Freeman and Katzoff (7) employed the same measure of tension and correlated the rank score with ranks of fifty college subjects' own ratings of their annoyance to six irritating conditions introduced during the task of reading. A coefficient of 0.49 was found. Lee (13) studied the relationship of adult and child scores on the Woodworth-Mathews questionnaire to measures of standing steadiness and knee-jerk amplitude (supposedly an indirect measure of muscular tension). She found no evidence of relation to the latter, and only slight relationship to the former. Seham (21), however, believes his data from normal children and those with functional disorders show the latter to be less steady on the Whipple test; and he shows in another study (22) that motor restlessness is slightly more prevalent in the "abnormal" subjects. A comprehensive study which bears indirectly upon the problem is that of Darrow and Heath (2). From 23 measures of physiological reaction to stimuli and from responses to neurotic and introversion-extroversion questionnaires, physiological syndromes and personality constellations were developed. While none of the resulting correlation coefficients was large, the authors conclude that these groups of variables may be arranged simultaneously in two continuously overlapping series, both characterized by something akin to hypo-reactivity at one extreme and hyper-reactivity at the other. Perhaps most insistent concerning the relationship between muscular processes and emotional unstability is Jacobson (10). He reports marked success in treating chronic cases of neurasthenia (which he terms neuromuscular hypertension) with his technique of progressive relaxation.

The present paper approaches this general problem from a slightly different avenue. Recently the writer (25) submitted a criticism of Pavlov's (19) concept of internal inhibition. It was argued that much of the behavior which

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[1] From the laboratory of The Orthogenic School, The University of Chicago.

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Pavlov seeks to explain in terms of internal inhibition may more simply be related to muscular processes per se. It was claimed that

(a) Decrement in muscular tension usually will be accompanied by a general decrement in response;
(b) Increment in muscular tension usually will be accompanied by a general increment in response;
(c) The inhibition of a conditioned response may occur without the accompaniment of muscular relaxation and therefore without the phenomenon of general response decrement; and
(d) When muscular relaxation accompanies the inhibition of a conditioned response, decrement in response will be generalized, and the total process must be regarded as two-fold.

With these premises, and their corollaries, one may rephrase many of Pavlov's statements involving the explanatory concept of internal inhibition. This is possible because throughout the experimental work in his laboratory the highly controlled experimental conditions were such as to induce muscular relaxation when no reinforcing agent was used. Thus in most of his work involving extinction of conditioned responses the experimental decrement is combined and confused with the generalized decrement in response associated with reduced muscular tension.

Among Pavlov's many keen observations were some of particular interest concerning the personalities of his experimental subjects. Following the old humoral classification, he speaks of the sanguine and the choleric, as contrasted with the melancholic and the phlegmatic. The former two are classified as excitable animals, while the latter fall at the opposite extreme and are referred to as inhibitable -- those in whom inhibition predominates. Although he does not speak in terms of a normal curve, it is quite clear that he regards these descriptions as extremes of a distribution. The excitable animals are those who are

> "...extremely vivacious, always sniffing at everything, gazing at everything intently, and reacting quickly to the minutest sounds...They can never be made to keep quiet either by orders or by a mild physical punishment." (19, p. 286)

He continues to say that great care to vary the stimuli and environment must be utilized with this kind of dog, and that under that type of regime they make excellent subjects, but the stability of their negative reflexes is never excellent.

The other kind of dog manifests excessive or moderate tendency to inhibition. In every new and slightly unfamiliar set of surroundings such animals are restrained in their movements. They are in general submissive in appearance. They cower and cringe. In such animals the conditioned reflexes, especially the inhibitory ones, remain extremely stable and regular.

During the establishment of a progressively longer delayed response, Pavlov says,

> "The dog with a predominant tendency to inhibition mastered the problem of the longer delay straight ahead and without any nervous disturbances; the dog with a predominant tendency to excitation reacted to the problem is quite a different manner. It began to enter into a state of general excitation, and with a further prolongation of the delay, ...became quite crazy, unceasingly and violently moving all parts of its body, howling, barking, squealing intolerably." (19, p.294)

Now if the concept of "internal inhibition" be dropped, what becomes of the inhibitable animal, and where does the excitable animal fit into the scheme? In the first place, according to the previous analysis, (25), drowsiness and sleep in the experimental stand are the result of a reduction in muscular tension. In the second place, from the experimental work on muscular tension, relatively greater magnitude and speed of response are known to be associated with increased muscle tension. In the third place, by the previous analysis, consistency or stability of response would be associated with more or less stable muscular tension. Pavlov's "excitable" animals might then be described as those with relatively higher and unstable muscular tension levels.

We have then an hypothesis educed from Pavlov's chance observations on individual differences and from a translation of his concept of internal inhibition. Whether Pavlov did or did not imply continuity in the excitation-inhibition classification he employed, we shall follow the trend of thought away from dichotomies or types of personalities or temperaments and think in terms of continnua. We shall tentatively infer also that individual differences observed in dogs will manifest themselves in higher animals. The hypothesis may then be stated:

> Characteristic levels of muscular tension are related to various forms of personal behavior, and tend to vary continuously in the higher animal forms.

From principles (a and b) cited above we know that decrement of muscular tension within the individual usually will be accompanied by a general *decrement in response, and conversely, that increment in muscular tension* within the individual will usually be accompanied by a general increment in response. Here decrement or increment of response refers to magnitude, speed, and presumably frequency of response. We may infer that the same relations will hold for the group; then --

1) Those individuals with relatively low levels of muscular tension will tend to manifest smaller magnitude, speed, and frequency of response than those individuals with relatively high levels of muscular tension.

The corollary follows:

2) Characteristic levels of overt muscular activity are related to various forms of personal behavior, and tend to vary continuously in the higher animal forms.

We have then the logical basis for Pavlov's description of his animals of easy excitation as lively and vivacious, and of his animals of strong inhibition as quiet and phlegmatic. Furthermore, in view of this corollary, which assumes a relationship between muscular tension and muscular activity, we have a ready means of investigating differences of personal behavior in their relationship to muscular tension.

From these two premises we can formally develop some of Pavlov's observations. He says that inhibitory conditioned reflexes in these (excitable) animals are unstable. (19, p. 289) Rephrasing, we may state,

3) There is a positive relationship between muscular tension or muscular activity and unstability of certain learned responses.

Further, since unstability of response is characteristic of emotional behavior,

4) There is a positive relationship between muscular tension or muscular activity and emotional behavior.

Pavlov again states (19, p.288) that excitable animals are in most cases aggressive. Restated,

5) There is a positive relationship between muscular tension or muscular activity and aggressiveness.

In comparing the behavior of his two types of experimental subjects in a frustrating situation Pavlov claims (19, p.294) that excitable animals become quite irritable. Restated,

6) There is a positive relationship between muscular tension

or muscular activity and irritability.

These deductions present a picture of interrelation between muscular processes and certain aspects of temperament or personality which are in accord with the literature already cited. Specifically, they lead to the following conclusion:

> Measures of muscular tension, overt muscular activity, unstability of response, emotional behavior, irritability, and aggressiveness, when obtained from the same population, will be positively intercorrelated.

The remainder of this paper deals with preliminary experimentation concerning the tenability of this conclusion.

The subjects of the experiment were seven resident boys of the Orthogenic School ranging in chronological age from 10/0 to 14/1 years, in mental age from 8/2 to 15/4 years, as determined by the Stanford-Binet scale, and in I.Q. from 81 to 128. They offered a wide variety of behavior problems. Only one, a former cretin, had continued medication during the seven month experimental period, and because of this factor his data have not been included in the present analysis.

The postulated relationships involve the following variables:

(a) muscular tension
(b) overt muscular activity - (speed, magnitude, and frequency of response)
(c) stability of response
(d) emotional behavior
(e) aggressiveness
(f) irritability

The measurement of muscular tension, not standardized and offering many difficulties, was attempted by several indirect techniques. Apparatus for a direct measure in terms of action potentials was not available. Pressure on a hand dynamometer during responses to the Woodrow-Lowell (26) revision of the Kent-Rosanoff word list failed to distinguish between the subjects and the data have not been used. Two measures of electrical skin resistance were employed. Wenger and Irwin (24) have shown that individual apparent skin resistance of the palmar surfaces increases as the skeletal musculature is relaxed, and that it decreases as muscular tension occurs. These results have been corroborated by Freeman and Simpson (8). On the assumption that individual variations will hold true for the group, absolute skin resistance is assumed to vary inversely with individual differences in muscular tension.

The data on skin resistance include measurements made during three to eight ten-minute periods per subject.[2] The subjects were seated with the instructions to remain as quiet as possible. The neutral electrode was a zinc plate attached to the ulnar surface of the left forearm. It was coated with Cambridge electrode jelly to minimize the resistance of the surface it covered. The active electrode, also zinc, was attached to the left palm. The electrolyte was a paste of kaolin and 0.9 zinc sulphate solution. The mean of the initial readings in ohms constitute measure Number 30 of Table 1. Variable Number 31 is the mean in ohms of readings at minute intervals read from the photographic record as described by Darrow (1).

Another measure related closely to muscular tension is represented as Number 32 of Table 1, the per cent rise in skin resistance. Since skin resistance increases as muscular relaxation occurs, the number of minutes in which rise of resistance occurred is a measure of the number of minutes during which muscular relaxation took place. Therefore by comparing each minute reading with the previous measurement and tabulating it as a rise or fall, the per cent of minutes during which relaxation took place may be determined. The variable may be regarded as a time sampling measure of muscular relaxation in an experimental situation.

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[2] The skin resistance measurements were made with the Darrow Behavior Research Photopolygraph (1). The author is indebted to Dr. Helen Koch of the University of Chicago for the loan of this apparatus.

One other variable is included which is presumed to be an indirect measure of muscular tension. During determinations of basal metabolic rate (which appear as variable Number 29, and which were included because of their possible relationship to several of the variables under consideration) it was noticed that individuals who appeared to experience most difficulty in relaxation manifested extremely variable respiration curves. On the other hand the individuals who relaxed easily and maintained that state manifested stable and rhythmical curves of respiration. It was believed, therefore, that variability of respiration amplitude was related to covert muscular activity. The standard deviation of these amplitudes for each subject were determined and appear as variable G. It and Number 29 were based on two to five experimental periods per subject. Standard Benedict-Roth apparatus was employed. Metabolic rate is in terms of the Boothby-Sandiford modification of the Dubois norms.[3]

The Downey Will-Temperament Test (4) was included in this experiment not only because it is one of the few tests which purport to measure temperament, but because of the experimenter's interest in that portion of the test referred to as "motor inhibition." If muscular tension is characterized by speed *and magnitude of response, then a task which calls for the inhibition of speed* and results in a minimum response amplitude should be performed better by the individual who characteristically operates at a low level of muscular tension. The test requires that the subject write a test phrase as slowly as possible. This test appears in Table 1 as Number 22.

Measures Number 26, systolic blood pressure, Number 27, diastolic blood pressure, and Number 28, pulse pressure, represent means obtained from a series of determinations on different days and were included because of Jacobson's (10) assumption that arterial hypertension bears some relationship to muscular hypertension. The auscultatory method was employed with the subject seated and the cuff attached to the upper left arm. The means were translated into standard scores derived from the age norms published by Richey (20) on over 1700 cases, thus eliminating the factor of chronological age. Diastolic pressure was taken at the incidence of the fifth or silent phase.

The measurement of individual differences in overt muscular activity has proceded along two lines--measures of frequency, and measures of speed. Under the first category are the following:

A. Rating of general activity --represents the mean of ratings by nine staff members of the Orthogenic School, all of whom were in daily contact with the subjects. They were instructed, "Will you please rate the following boys in relation to their general activity. The individual who is typically the most active will be rated as '1'; the boy closest to him in amount of general activity will receive a '2'."

B. Arm activity, and C, body activity --were measured by the Olson (18a) time-sampling technique. The measures were taken in the schoolroom when the subjects were engaged in reading. They involve a daily series of ten-second samples over a period of three weeks. Body activity included any movement of the trunk or legs.

D. Activity just before sleep, and E, activity during sleep[4]---represent mechanical measurements taken with Harvard work-adders which were attached to the bed-springs. The recording meters were read at hourly intervals by the nurse in charge. The subjects retired between 9:30 and 10 P.M. The first reading was taken at 10 P.M. and the differential between it and the 11 o'clock reading has been regarded as a measure of pre-sleep activity. The data represent means of readings over a four month period and were rendered comparable by correcting for differences in weight of the subjects and sensitivity of the bed-springs.

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[3] The author is indebted to Dr. Margaret Sandiford of the University of Chicago Clinics for the determination of some of the metabolic rates. The remainder were obtained with apparatus made available through the courtesy of Dr. N. Kleitman of the Department of Physiology, University of Chicago.

[4] These data were taken in collaboration with Drs. N. Kleitman and N. R. Cooperman of the Department of Physiology, who are using them in another connection.

Item F, which for want of a better name has been called uncontrollable activity, represents mean number of leg movements per minute which could not be or were not controlled when the subjects had been instructed to remain seated as quietly as possible for a series of ten minute periods during the skin resistance measurements. The blood pressure cuff of the Darrow apparatus was attached to the calf of the right leg, and any movement of that member was recorded as an abrupt change in the blood pressure curve on the photopolygraph tape.

Speed of response is represented by several measures. Number 18 is speed of writing on the Downey Will Temperament test. Number 24, mean rate of tonguing (in this case the ability to pronounce rapidly the consonant "d"), was recorded dictaphonically for a series of five-second periods on different days under instructions to tongue as rapidly as possible. Number 25, mean rate of key tapping under instructions to tap as rapidly as possible, involves records of a series of ten-second periods on different days obtained by means of a magnetic counter. The hand capable of making the most speed was used.

Number 23, median speed of movement, is a mixed measure. Besides Number 18, seven sets of data on normal speed of movement were collected, no one of which was reliable. By taking the median of the combined obtained rankings, a variable was obtained which reliably distinguished between the subjects. The data include Number 18, speed of writing, which was also listed as a separate measure because it was one of the Downey tests; a rating by staff members of speed of normal speech; speed of recitation of an overlearned paragraph from Lincoln's Gettysburg Address; speed of counting to thirty at a rate which was neither slow nor fast; speed of transversing an overlearned pattern on a raised nail stylus maze; speed of counting the 121 nails on that maze; speed of choice key tapping, where the subject was instructed to tap at a rate which seemed to him neither slow nor fast; and choice of a metronome rate which seemed neither slow nor fast, obtained by repeatedly increasing, then decreasing the rate of the metronome until the subject had made a series of choices. All of these measures except the rating of speed of speech, and the speed of recitation represent data collected on a number of different days. In only one, maze performance, did the subjects realize they were being timed.

Another measure which Downey at least includes in the Speed Group is Number 19, Freedom from Load, from her Will-Temperament test. She regards it as an index of tendency to maintain speed without external pressure. It is the ratio obtained by dividing the normal by the speeded time of writing, the material being the subject's name and a test phrase, each written twice under each condition.

Two other phases of the Downey test may be described here. One, Interest in Detail, Number 20, is measured by the exactness with which a model of handwriting is copied when instructions are given to copy it as exactly as possible. The other, Number 21, Volitional Preservation, is determined by keeping a record of the amount of time taken to devise a disguised handwriting.

Although measures of stability and emotional behavior obviously admix, two variables were available which afforded sufficient data for a measure of variability. One is shown as Number 34, which is the standard deviation of activity during sleep. The standard deviation of pre-sleep activity also was obtained, but was found to be unreliable.

The other, Number 17, depicts what Spearman refers to as "oscillation." Following Madegan (15), two forms of Spearman's Straight and Curved Capitals test were used. The test requires the subject to distinguish the curved or straight characters of a series of capital letters coursing over a page by marking a straight or curved line underneath each. The subject places another mark at the instruction of the examiner every 15 seconds so that the variability of his rate of work may be obtained in terms of the average deviation from the mean. The individual with the least average deviation is the most stable worker, or oscillates least. This test was the least popular of the experiment. In spite of its low reliability (.50) it has been retained in part of the present analysis because of the interest which has been manifested in it.

It should be emphasized that any measure of emotional behavior is in a sense a measure of unstability though the converse does not hold. Emotions are by definition variants. The stable person is calm, phlegmatic, unemotional. Such a measure as frequency of emotional outbursts, Number 4, is thus essentially a measure of unstability. This item represents observations made over a period of three months by three staff members. Instructions were as follows: "A negative emotional outburst, for the purpose of this study, will mean a decided change in behavior which arises out of some FRUSTRATING situation and which persists for one or more minutes. It will include crying, sulking, grumbling, screaming, swearing, whining, striking, balking, etc." Rankings were obtained directly from the number of outbursts reported.

Other measures of emotional behavior include: Number 5, emotional lability, a rating by nine staff members of that behavior popularly known as "sensitiveness." Instructions to raters were, "We regard some people as 'thin-skinned' or 'easily hurt.' Their feelings seem relatively unprotected. They might be called emotionally labile. Will you rate---" etc. Number 8, the Woodworth-Mathews Personality Inventory, was scored in terms of the amount of positive or negative deviation from the age norms given by Mathews (16). Number 9, Schedule A, Number 12, Social B III, and Number 13, Emotional B IV, represent the mean judgments of three staff members in rating the subjects on the Haggerty-Olson-Wickman Behavior Rating Schedules (18). Schedule A is a composite of behavior problems while Schedule B attempts to differentiate between problems lying in intellectual, physical, social, and emotional spheres. All parts of the scale were used, the intellectual and physical divisions appearing as items Numbers 10 and 11 of Table 1.

Variables Numbers 15 and 16 were obtained from the word association test. The Woodrow-Lowell (26) revision of the Kent-Rosanoff list was used and presented following the manner employed by Luria (14). In this case the fingers of the subject's hands rested on two metal cylinders covered with rubber sheeting. The subject was instructed to press with the right hand when making a verbal response. Pressure changes exerted on the rubber tambours were pneumographically recorded on a polygraph tape. The subject and experimenter spoke into a Stoelting voice key and the incidence of both the stimulus and the response words was magnetically recorded. Variable Number 15 is the number of delayed responses. Following Wells (23) a response was regarded as delayed if it occurred three seconds or more after the stimulus word. Number 16 is the number of individual responses in terms of the Woodrow-Lowell norms (26). Any response appearing in zero or one case in a thousand was regarded as an individual response. Data concerning pressure changes from the involuntary hand and variability in the voluntary hand did not reliably differentiate between the subjects and so were discarded from the present analysis.

Variable Number 33, mean number of spontaneous galvanic skin responses per minute was obtained at the same time as variables Numbers 30, 31, 32, and F.

One other item should perhaps be classified with this group, Number 7, Good-naturedness. It is particularly a measure of behavior which has been referred to as "irritability," but its similarity to emotional behavior is apparent. It and the sole measure of aggressiveness, Number 6, were obtained from ratings by staff members.

Number 35, morphological index, was included because of the perennial interest in the relation of physique to temperament. Following McCloy (17) the form $\frac{\text{weight}^{1/3}}{\text{height}}$ was employed.

The foregoing description of the experimental procedure omits mention of several behavior items which were measured. All portions of the Downey Will-Temperament test were given but only the four mentioned distinguished between the subjects. Other data also were excluded because they did not reliably distinguish between the subjects. In this class fall measurements of pulse rate, spontaneous blood pressure variability, hand tremor on the Whipple Steadiness test and on the Luria apparatus, tachycardia after physical exertion, and perserverance of error on the raised nail maze. With the exception of Number 17, oscillation, no measure has been included whose reliability coefficient, when obtainable, was less than .80. Reliability was determined by obtaining the rank difference correlation coefficients for odd and even measures. These coefficients are shown in the following tabulation.

	Measure	p		Measure	p
	A. General activity	.95		16. Word assn. indiv. resp.	.89
	B. Arm activity	.96		17. Oscillation	.50
	C. Body activity	1.00			
	D. Pre-sleep activity	.94			
	E. Activity during sleep	.92	Downey Will-Tempera-ment	18. Speed of writing	.89
	F. Uncontrollable activity	.93		19. Freedom from load	.75
	G. S.D. Respir. ampl.	.88			
	5. Emotional lability	.68		23. Speed of movement (med)	.85
	6. Aggressiveness	.94		24. Rate of tonguing	1.00
	7. Good-naturedness	.64		25. Rate of tapping	.96
				26. Systolic blood pressure	.91
Haggerty-Olson-Wickman Behavior Rating Schedules	9. Schedule A	.61		27. Diastolic blood pressure	.76
	10. Intellectual B I	.80		28. Pulse pressure	.94
	11. Physical B II	.93		29. Basal metabolic rate	.92
	12. Social B III	.94		30. Initial skin resistance	.79
	13. Emotional B IV	.88		31. Mean skin resistance	.96
	14. Schedule B-total	.96		32. Per cent skin resistance	.85
				33. Galvanic skin responses	.96
	15. Word ass'n. delayed response	.83		34. S.D. activity during sleep	.76

RESULTS

Since only six subjects were available for this experiment, it is obvious that no generalizations can be drawn. The results must be considered as pertaining to these six subjects only, and their sole value will be in the corroboration they may give to hypotheses already advanced, and in any new hypotheses to which they may give rise. In view of these considerations the value of a detailed presentation of the data is questionable. The description of the results will be confined therefore to an analysis of the table of rank-difference correlation coefficients which the data afford. The coefficients are shown in Table 1. While the table contains many items of individual interest a revision is needed before a systematic interpretation is possible.

According to the hypotheses which gave rise to the experiment, a table of

TABLE 1

RANK DIFFERENCE CORRELATION COEFFICIENTS FOR FORTY-TWO VARIABLES AND SIX SUBJECTS

		A	B	C	D	E	F	G	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
A. General activity (R)																																											
B. Arm activity (TS)		-.73																																									
C. Body activity (TS)		.84	-.31																																								
D. Pre-sleep activity (R)		.53	.14	.82																																							
E. Activity during sleep (M)		.24	-.14	.14	.57																																						
F. Uncontrollable activity (O)		.29	.20	.54	.83	.31																																					
G. S.D. Respir. amp. (metabol.)		.06	-.27	.09	-.22	-.77	.39																																				
1. Chronological age		.19	-.20	-.00	.09	.71	.37	-.31																																			
2. Mental age		.15	-.46	-.57	-.49	.57	-.20	-.14	.77																																		
3. Intelligence quotient		.39	-.65	-.14	-.54	-.03	-.27	.20	.37	.83																																	
4. Emotional outbursts (O)		.70	-.64	.64	.26	-.19	.54	.61	-.13	.34	.43																																
5. Emotional lability (R)		.47	-.24	.43	.57	-.03	.60	.43	.49	.36	.35	.19																															
6. Aggressiveness (R)		.93	-.83	.68	.28	-.23	.26	.13	.14	.28	.80	.61	.64																														
7. Good-naturedness (R)		-.57	.46	-.45	-.25	.29	-.43	-.71	-.08	-.26	-.21	-.77	-.57	-.74																													
8. Woodworth-Mathews Pers. Inv.		.39	-.35	.04	-.42	-.30	-.44	.21	.10	.56	.73	-.09	.41	.97	-.09																												
9. Schedule A	Haggerty-Olson-Wickman Behavior Rating Schedules	.64	-.57	.49	.27	-.24	.56	.71	.26	.14	.21	.73	.77	.77	-.81	.16																											
10. Intellectual B I		-.19	.28	-.20	.09	-.09	.31	.57	-.14	-.28	-.31	.41	-.26	-.14	-.31	-.75	.55																										
11. Physical B II		-.24	.70	.27	.47	-.18	.64	.56	-.21	-.61	-.73	.07	.24	-.59	-.17	-.75	.24	.76																									
12. Social B III		.37	-.19	.21	.19	-.30	.38	.84	.07	.04	.21	.77	.50	.55	-.88	-.08	.80	.81	.45																								
13. Emotional B IV		.50	-.51	.51	.28	-.25	.68	.77	.14	.09	.26	.81	.84	.86	-.81	-.04	.84	.54	.19	.99																							
14. Schedule B—Total		-.21	.20	-.03	.14	-.57	.52	.77	-.09	-.20	-.14	.15	.28	.14	-.06	-.59	.68	.65	.75	.80	.65																						
15. Word assn. delayed resp. (M)		-.29	.71	.20	.27	-.54	.57	.43	-.43	-.72	-.68	-.21	.21	-.56	-.06	-.16	.18	.09	.67	.19	.09	.39																					
16. Word assn. indiv. resp.		-.04	-.31	-.49	-.54	-.20	-.55	.32	.37	.66	.66	-.11	.26	.28	-.49	.24	.49	.57	-.14	.64	.80	.54	-.51																				
17. Oscillation		-.55	-.09	-.30	-.60	-.25	-.60	.70	-.02	-.14	.39	.53	-.77	-.20	.11	-.16	-.31	.49	.06	.07	-.05	.20	-.25	.36																			
18. Speed of writing	Downey Will-Temperament	-.20	.09	-.26	-.09	-.26	.37	.86	.05	.05	.05	.53	.53	.09	-.57	-.39	.54	.88	.39	.86	.77	.94	.09	-.71	.57																		
19. Freedom from load		-.25	.26	-.22	.28	-.09	.13	-.05	-.26	-.31	-.34	-.44	-.57	-.66	.23	-.67	-.20	.57	.84	-.02	-.14	.51	.77	-.43	-.11	.14																	
20. Interest in detail		.21	-.40	-.14	-.06	.40	.05	-.47	.65	.65	.57	.17	-.23	.11	.14	-.17	-.08	.50	-.26	-.04	.23	-.16	-.07	.58	.21	.11	-.40																
21. Volitional perseveration		.10	-.20	-.23	.26	.54	.26	-.71	.60	.31	.39	-.23	-.28	-.21	.79	-.50	-.20	.30	-.01	-.21	-.14	-.20	-.80	-.09	-.14	-.05	-.05	.89															
22. Motor inhibition		.50	-.66	.21	.05	.49	-.57	-.60	.03	.03	.31	.16	-.57	.31	.29	.21	-.31	-.43	-.67	-.47	-.37	-.71	-.71	-.27	.22	-.02	-.05	.54	.45														
23. Speed of movement (sec.) (M,R)		.71	-.57	-.09	-.26	-.48	.05	.05	-.24	.84	.43	-.61	.24	.49	-.74	.07	.64	.60	.21	.67	.83	.77	-.09	.77	.49	.05	-.31	.03	-.31	-.31													
24. Rate of tonguing (M)		.76	-.63	.37	.24	.22	.53	.24	.29	.31	.54	.26	.09	.77	-.57	.06	.54	.59	-.21	.50	.60	.20	-.08	.37	.14	.31	-.16	.03	.57	.49	.54												
25. Rate of tapping (M)		.82	-.71	.49	.27	.54	.49	.01	.80	.40	.48	.64	.43	.77	-.57	.07	.68	.09	-.19	.47	.60	.14	-.54	.51	-.31	.20	-.53	.65	.49	.57	.31	.59											
26. Systolic blood pressure		-.21	.29	-.20	.14	.28	.26	-.39	-.09	-.25	-.45	.21	-.54	-.51	.03	-.67	-.09	.89	.61	.24	.20	.48	-.14	.09	.49	.60	.37	.46	.54	-.09	.15	.25	.09										
27. Diastolic blood pressure		-.56	-.37	-.54	-.85	-.51	-1.00	-.77	-.37	.20	.37	-.21	-.60	-.28	.64	.47	-.69	-.57	-.61	-.43	-.80	-.54	-.57	-.09	.80	-.37	-.43	.03	-.15	.57	-.28	-.20	-.49	-.25									
28. Pulse pressure		.24	.28	.49	.77	.26	.71	.03	-.14	-.60	-.66	.33	-.06	.32	-.81	-.81	.26	.66	.76	.36	.37	.49	.28	-.31	-.05	.57	.54	.11	.27	-.09	.05	.16	.38	.71	-.71								
29. Basal metabolic rate		.47	-.60	.01	-.39	.09	.31	.49	.46	.80	.66	.73	.43	.66	-.74	.16	.77	.57	-.06	.78	.85	.54	-.43	.05	.02	.66	-.54	.46	.14	-.09	.77	.77	.77	.14	-.51	.03							
30. Initial skin resistance		-.39	-.03	-.42	-.47	.20	-.71	-.60	-.26	.03	-.03	-.24	-.84	-.49	.71	-.12	-.63	.03	-.30	-.81	-.66	-.49	-.54	-.20	.66	-.38	-.14	.46	.37	.54	-.35	-.05	-.31	.57	.71	-.14	-.57						
31. Mean skin resistance		-.10	-.38	-.26	-.51	.43	-.60	-.71	-.09	.14	.09	-.13	-.63	-.26	.63	-.13	-.71	-.09	-.44	-.61	-.60	-.60	-.71	-.38	.49	-.57	-.11	.43	.34	.77	-.11	.20	-.03	.31	.60	-.09	-.29	.94					
32. Per cent rise skin resistance		.13	-.64	-.14	-.37	.57	-.66	-.60	-.05	.31	.37	.34	-.66	.25	.46	.16	-.54	-.26	-.67	-.53	-.49	-.66	-.63	-.14	.85	-.45	-.60	.65	.42	.89	-.50	.57	.14	.09	.66	-.22	-.02	.83	.94				
33. Galvanic skin response		-.18	.22	.09	.49	-.14	.77	.65	.05	-.43	-.60	.01	.37	-.20	-.31	-.56	.45	.82	.85	.34	-.19	.77	.71	.09	-.28	.60	.77	-.51	-.08	-.83	.25	-.28	-.08	.57	-.77	.60	.09	-.80	-.71	-.89			
34. S.D. activity during sleep		-.27	.09	-.43	-.14	.77	.09	-.80	.77	.63	.09	-.36	-.14	-.37	.32	-.50	-.26	.14	-.27	-.21	-.25	-.14	-.54	.56	-.14	.63	-.03	.83	.85	.09	-.56	.09	.29	.37	-.09	-.13	.20	.31	.37	.23	-.05		
35. Height/$\sqrt[3]{\text{Weight}}$		.07	-.50	-.43	.03	.57	-.14	-.37	-.22	-.14	-.16	.50	-.77	-.09	.22	-.56	-.31	.49	.07	-.10	-.09	-.05	-.56	-.34	.60	.14	-.08	.85	.80	.54	.09	.49	.30	.77	.84	.49	.05	.71	.77	.66	-.26	.29	

R—Rating Scale, TS—Time-Sample observations, M—Mechanical measure, O—Observation report positive correlation coefficients would be expected. Inspection of Table 1 shows many negative coefficients. Since the measures were correlated with regard to magnitude only, negative coefficients are to be expected for some variables. Reflection of traits, however, did not entirely eliminate them. It was determined, therefore, to construct a new, positively correlated table around a group of highly intercorrelated variables.

In the absence of clearly defined measures of muscular tension, the internally consistent measures of overt muscular activity were used as the nucleus of the revised table. It is apparent from Table 1 that these are measures A, general activity as rated, C, body activity in the school room, D, pre-sleep activity, and F, uncontrollable activity in an experimental situation. Although their mean intercorrelation of .66 is not as high as might be expected it is positive throughout and suggests a common factor which would be measured more accurately by a combination of all than by any one alone. Accordingly, a composite variable ACDF was set up by the following formula cited by Holzinger (9, p.37).

$$\sigma^2_{1+2+3+\ldots+n} = n+2(r_{12}+r_{13}+\ldots r_{n-1,n})$$

From the standard deviation of the composite, the correlation of the composite with any test is obtained by

$$r_{i(1+2+\ldots+n)} = \frac{\sum_{j=1}^{n} r_{ij}}{\sigma_{1+2+\ldots+n}}$$

By this means the correlation of the composite ACDF with each test of Table 1 was determined. Table 1 was then reinspected in an attempt to locate other groups of tests which also might be combined. One pair, Numbers 24 and 26, rate of tonguing and rate of tapping, correlate .89. Combined they probably form a more accurate measure of maximum rate of movement than does either alone. Another such group includes tests Numbers 9, 12, and 13 of the Haggerty-Olson-Wickman Rating Scale, their mean intercorrelation being .94. Since each alone is a mixture of ratings on several questions, it seemed likely that a further combination would clarify rather than distort the picture. The new composite will be referred to as 9-13, "social behavior problems."

The revised table was then constructed by adding tests in the order of their correlation with the composite ACDF, if their correlations with each of the previously entered tests was positive. Coefficients within the range -.01 to -.19 were considered insignificantly negative, or zero. Tests were reflected if all coefficients were negative. Tests Numbers 7, 27, 30, 31, and 32 were reflected and are marked hereafter with an "x."[5]

Since the intercorrelation of tests A, C, D, and F did not approach unity, the composite ACDF was replaced in the obtained table by the individual tests. As this resulted in the appearance of only three more insignificantly negative coefficients, and one of -.26, which also is probably insignificant, the table was left in this form. It appears as Table 2. Since variables F and 27x have a correlation of unity, only one set of coefficients has been included. It thus represents both F, uncontrollable activity, and 27x diastolic blood pressure.

The next step was the analysis of Table 2, presumably into groups of

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[5] From this revision certain tests were omitted. These include Number 17, oscillation, because of low reliability; Number 14, Schedule B-total, because it represents merely a summation of measures 10, 11, 12, and 13; and Number 16, speed of writing, since it already forms a part of measure Number 23, median speed of movement.

TABLE 2

VARIABLES FROM TABLE 1 WITH POSITIVE INTERCORRELATIONS

D	Pre-sleep activity																	
F,27x	Unc'l. activity,D.B.P.	.83																
28	Pulse Pressure	.77	.71															
C	Body Activity	.83	.54	.49														
A	General Activity	.53	.36	.24	.84													
5	Emotional lability	.37	.60	.00	.43	.47												
30x	Initial skin resist.	.49	.71	.14	.49	.39	.94											
31x	Mean skin resistance	.31	.60	.09	.26	.10	.83	.94										
32x	Percent rise skin res.	.37	.66	.26	.14	.00	.66	.83	.94									
7x	Good-naturedness	.23	.54	.31	.40	.27	.57	.71	.63	.46								
9-13	Social behavior prob.	.28	.61	.34	.34	.51	.62	.71	.65	.53	.91							
23	Median speed mov'm't.	.00	.09	.09	.00	.21	.14	.26	.31	.20	.74	.80						
4	Emotional outbursts	.16	.21	.33	.44	.70	.19	.24	.13	.00	.77	.79	.81					
29	Basal metabolic rate	.00	.31	.03	.03	.47	.43	.37	.26	.09	.74	.81	.77	.73				
6	Aggressiveness	.26	.26	.03	.66	.93	.54	.49	.26	.00	.74	.68	.49	.81	.66			
24-25	Rate of movement	.26	.36	.27	.44	.81	.27	.18	.09	.26	.59	.59	.44	.76	.79	.79		
G	S.D. respir. amp.BMR	.00	.20	.03	.09	.16	.43	.60	.71	.60	.71	.79	.83	.61	.49	.43	.09	
	Means	.38	.56	.27	.41	.48	.54	.45	.37	.57	.62	.37	.47	.43	.49	.43	.41	.43
		D	F,27x	28	C	A	5	30x	31x	32x	7x	9-13	23	4	29	6	24-25	G

tests which have some factor in common. According to Holzinger, (9, p.23), "This grouping is accomplished by means of a 'coefficient of belonging', the B-coefficient, which is the average of the intercorrelations of a certain group of tests divided by their average correlation with all the remaining tests. The B-coefficient gives an objective measure of the extent to which the tests in this group belong together in ascertaining the underlying factor." The work is begun with the two tests which have the highest correlation, and continued by adding the test which correlates the highest with the preceding tests. When the B-coefficient drops appreciably a new argument is begun with the next highest coefficient among tests not already involved in the first group.

Since the B-coefficient analysis indicated three clearly defined groups of tests it was determined to submit the data to factorial analysis. Holzinger's (9) bi-factor method, which assumes a general and group factors in a positive correlation matrix, was employed. The obtained factor pattern appears as Table 3.

The third and final step in the analysis aimed to discover the relationships of those tests omitted from Table 2 to (a), all tests included in Table 2, and (b), tests measuring factor groups of Table 3. These relationships are shown in Table 4 and were obtained by means of the same formula used in step one. Thus, variable Number 33 correlates .56 with composite D, F-27x, 28, and C; it correlates .68 with composite 5, 30x, 31x, and 32x; and it correlates .12 with the composite of tests measuring factor III. The mean of the correlations with the three composites, .45, is an approximation of its correlation with Table 2 as a whole.

DISCUSSION

In the discussion of results little direct attention need be given Table 1. The table has been included for purposes of reference, and in order that the reader may refer to any items which for him hold particular interest.

It will be recalled that relationships were postulated between individual

TABLE 3

BI-FACTOR PATTERN OF TESTS FROM TABLE 2

			I	II	III	h^2
D	Pre-sleep activity	.44	.94			1.07
F,27x	Unc't act,-D.Bl.Pr.	.80	.39			.79
28	Pulse Pressure	.25	.66			.50
C	Body activity	.56	.65			.74
A	General activity	.34	.44		.49	.55
5	Emotional lability	.74		.43		.73
30x	Initial skin resistance	.87		.55		1.06
31x	Mean skin resistance	.64		.79		1.03
32x	Percent rise skin resist.	.56		.66		.75
7x	Good-naturedness	.72			.58	.85
9-13	Social behavior problems	.82			.62	1.06
23	Median speed of movement	.17			.82	.70
4	Emotional outbursts	.33			.91	.94
29	Basal metabolic rate	.77			.84	.78
6	Aggressiveness	.51			.69	.74
24-25	Rate of movement	.42			.60	.54
G	S.D. respiration amp.BMR	.17		.77	.61	.99

TABLE 4*

RELATIONSHIP OF TESTS OMITTED FROM TABLE 2 TO TESTS INCLUDED IN TABLE 2

		Tests of factor groups			
		I	II	III	Mean
33	Galvanic skin responses	.56	.68	.12	.45
11	Physical behavior problems	.54	.38	.02	.31
34	S.D. activity during sleep	-.16	-.29	-.34	-.26
22	Motor inhibition	-.03	-.68	-.03	-.25
15	Word assn. delayed response	.34	.63	-.23	.25
10	Intellectual behavior problems	.26	.02	.36	.21
35	Weight1/3-height ratio	.10	-.77	.05	-.21
1	Chronological age	.07	.23	.17	.16
16	Word assn. individual responses	-.36	.23	.60	.16
20	Interest in detail	-.02	-.52	.21	-.11
B	Arm activity	.08	.18	-.58	-.11
21	Volitional perseveration	.24	-.43	-.07	-.09
2	Mental age	-.47	-.06	.26	-.09
8	Woodworth-Mathews Per. Inv.	-.47	.17	.16	-.05
19	Freedom from load	.39	.18	-.49	.03
E	Activity during sleep	.31	-.27	-.11	-.02
26	Systolic blood pressure	.26	-.35	.09	.00
3	Intelligence quotient	-.49	-.04	.52	.00

*Tests A and G omitted from their respective groups in these correlations because of overlap in group factors.

differences in (a) muscular tension, (b) overt muscular activity (speed and frequency of response), (c) unstability of response, (d) emotional behavior, (e) aggressiveness, and (f) irritability. Inspection of Tables 2 and 3 indicates that these relationships do obtain in the behavior of the six subjects of the experiment. Table 2 shows that measures in each of the above categories do cluster in a positive manifold. Table 4 shows tests which do not fall within that manifold.

The entries in the last column of Table 4 may be regarded as indices of the relationships between the omitted and included tests of Table 2. Entries have been made in the order of that relationship. It will be seen that tests 33, 11, 34, 22, 10, and 1 are alike in sign in their relationships to the groups of Table 3, and, after reflection of 22 and 34, might presumably belong in Table 2. Actually this is the case for all except Number 1, chronological age, which was not systematically related to any of the three groups, its correlation being only slightly more positive than negative, and low in most instances. The others, however, were omitted on the basis of only one or two negative correlations, which might well be attributed to chance. It is surprising indeed that, with so few subjects, more tests did not fall in this category.

The remainder of the tests of Table 4 are those which explain the large number of negative correlations, even after attempted reflection, in Table 1. It will be seen that they represent no systematic direction of correlation with the groups of Table 3. They are of particular interest for they should answer the question---do any of these measures tend to throw doubt on the postulated relationships? Little consideration need be given to measures 19, 20, 21 and 8. All four represent results from a single presentation of paper and pencil tests, the reliabilities of which may be questioned. Even though they be considered reliable, their nature is such that they need have little effect upon the conclusions. The same applies to 2 and 3, mental age and intelligence quotient, which were not expected to bear a systematic relationship. Items 15 and 16, delayed and individual response in the word association test, are also open to question concerning reliability, for in spite of the consistency with which they differentiated between the six subjects, they represent results obtained from only one test presentation of 100 stimulus words. It will be seen that each correlates over .60 with one of the three groups of Table 3 and low with the others. If the word association test were lengthened it seems possible that 15 and 16 might well cluster with the variables of Table 2. Number 35, morphological index, also shows a close relationship.

This leaves for consideration only measures B and E, arm activity in the school room and activity during sleep. Here the apparent contradiction of theory would be more serious were it not for the fact that four other measures of overt muscular activity are present. Inspection of Table 1 will show that these two variables did not correlate highly positive with the other four tests which were used to form activity composite ACDF. Arm activity was actually negatively related to the composite while activity during sleep was positively though insignificantly related. It can only be concluded that these two forms of activity are conditioned in these subjects by other factors.[6]

The proposed question can now be answered. None of the tests omitted from Table 2 offers important refutation for the conclusion that, for these six subjects, the original postulates may be regarded as substantiated. They do suggest that overt muscular activity is not a factor *per se*, and this inference is supported by the relatively low order of relation between tests A, C, D, and F. Possibly there is no such thing as a "hyperkinetic" child. The form of activity in which he manifests hyperkinesis probably must be stated.

There remains for consideration only the attempt to isolate group factors from Table 2. If the factorial method had already been applied to measurements of individual differences of this nature the present data would not justify the analysis. Since, however, no report of common factors in psychological and physiological behavior has yet appeared a preliminary attack on this problem seems warranted.

In view of the postulates it seems reasonable to regard the general factor, Δ, as muscular tension; however, the evidence from the factor loadings is by no means clear. Interpretation of factor I is complicated by the presence of Number 26, pulse pressure, and 27x, diastolic blood pressure. Since, however, all of the other tests in this group represent overt muscular activity, and since one of these tests has a perfect negative relationship with diastolic blood pressure, overt activity may be regarded as the dominant picture of the factor.

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[6] It is interesting to speculate on these conditions. Table 1 shows that in these six boys arm activity is related most closely to general inactivity, low intelligence, lack of aggressiveness, number of physical behavior problems and lack of ability for rapid reaction. Since all of the subjects of this study manifested behavior problems of various sorts this picture of apathy and aimless arm movements may be particular to these subjects. Activity during sleep is most closely related to age, rhythmical respiration during the metabolism experiment, variability of activity during sleep, volitional perseveration, and interest in detail. Since it is negatively correlated with most of the measures of muscular tension and the emotions, the speculation might be drawn that the calm, cautious individual is the more restless sleeper while the excitable, impulsive person "sleeps the sleep of the dead."

If this is an adequate interpretation it is logical to expect a high correlation with Number 33, since overt activity also results in galvanic skin responses. Table 4 shows the correlation coefficient to be .56. The correlation of .54 with Number 11, physical behavior problems, is rather meaningless due to the heterogeneity of the measure.

Factors II and III are even more difficult to interpret. They manifest a mixture of physiological and psychological measurements.

It is believed that in variable Number 5, emotional lability, lies the key to this factor. It will be recalled that this was the rating of what was popularly called "sensitiveness." Presumably a person who is sensitive is one who reacts to slight stimuli. By inference he might be expected to react to constant stimuli in an exaggerated manner. He would thus be more reactive, more excitable, than the less emotionally labile person, and his greater reactivity would be apparent particularly in unusual situations such as the experiments measuring skin resistance, basal metabolic rate, and word association. Tables 3 and 4 show this to be the case. Moreover, measures Numbers 22, 20, and 35 correlate over .50 with the four tests of this factor. The picture is thus logically expanded to emotional lability accompanied by the inability to inhibit a motor response, by lack of interest in detail, all housed in an underweight, overheight organism. The correlation of -.77 between the tests of group II and morphological index suggests that this factor is not apprehension conditioned by previous experience, but is a variable with a physiological basis. Perhaps further use of factor analysis with personality data will reinstate body-build as an index of certain phases of individual variability.

Factor III includes four of the five ratings -- A, activity; 7x, bad-naturedness; 9-13, social behavior problems; and 6, aggressiveness. If their clustering be explained in terms of halo-effect their correlation with the rest of the group remains unaccounted for. Viewed from the variables which correlate most highly with the factor--- 4, emotional outbursts; 29, basal metabolic rate; and 23, speed of movement- -the operation of the thyroid gland is suggested. Certain it is that in hyperthyroidism both emotional outbursts and speed of reaction are increased. The tests of Table 4 do not help in clarifying the evaluation. Let it be defined tentatively as thyroid function and the hypothesis put to experimental test.

The fact that these tentative factor designations do not seem to be mutually exclusive need occasion no concern. No illusions are held concerning their validity. Reliable factor loadings and, possibly, reliable factors cannot be expected from an analysis based on six cases. They do, however, furnish a definite pattern around which to fashion further research. Furthermore, they show that at least in these six subjects there is no dichotomy of physiological and psychological traits. Typical measures of personality differences which are often attributed to environmental influences are shown to cluster with measures of physiological differences and to bear definite relationships thereto. Impetus should be derived for further physiological studies of personality.

SUMMARY AND CONCLUSIONS

The hypothesis was derived that individual differences in characteristic level of muscular tension in the skeletal musculature are positively related to differences in 1) frequency of overt muscular activity; 2) speed of movement;

3) emotional behavior; 4) unstability of response; 5) aggressiveness; and 6) irritability. The postulates were put to preliminary experimental test with forty-two variables and six male subjects ten to fourteen years of age. The data yielded a table of positive correlation coefficients for 21 of the variables, including all those of fundamental importance for the preliminary confirmation of the hypothesis. A bi-factor analysis of the correlation matrix discovered a general factor (presumably muscular tension level or its analogue) and three group factors. No dichotomy of physiological and psychological variables was found. It is concluded that, for these six subjects, the data substantiate the hypothesis, and that the relationship of muscular processes to personality differences warrants further investigation.

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A COMPARISON OF CERTAIN PERSONALITY TRAITS AND INTERESTS IN DEAF AND IN HEARING CHILDREN

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Most comparative studies of deaf and of hearing persons have dealt with intellectual abilities. Pintner (8), Goodenough and Shirley (1), Peterson and Williams (6), and MacKane (4), using various tests, all reached the conclusion that deaf children on the average are mentally retarded. The findings of Long (2) and of Lyon (3), comparing hearing and non-hearing groups of children as to motor ability, are inconclusive, though Lyon reports that 44 per cent of the deaf boys he tested fell below the 30th percentile on the Minnesota Mechanical Ability Tests. Previous studies of the personality differences between deaf and hearing children by Madden (5), Rabinovitch (9), and Welles (10) have suggested a lack of initiative and have shown considerable evidence of personality maladjustment in both children and adults who are hard of hearing. Pintner (7) concluded from his test that the deaf are more neurotic, more introverted, and more submissive than those who hear normally, and Lyon found deaf boys presenting more emotional problems than hearing boys.

The purpose of the present study was to compare the responses of deaf and of hearing children in institutions as to certain personality and interest items. The two groups of subjects comprised 128 children at the School for the *Deaf at Faribault, Minnesota, and 156 children at the School for Dependent* Children at Owatonna, Minnesota. Both groups were known to be intellectually retarded, so that the factor of intelligence was fairly adequately controlled; and since all the children were under institutional care, the socio-economic factor was also controlled.

Only those subjects were included who had a reading age of nine years or over, as determined by the Stanford-Achievement Reading Test. Chronological ages ranged from thirteen through eighteen years. Reading ages of the hearing children approximated their chronological ages more nearly than did reading ages of the deaf children.

The groups selected to take the personality and interest tests are shown in Table 1. The two groups were paired as closely as possible on the basis of age and sex. There were 25 pairs of boys and 32 pairs of girls.

The children filled out the test blanks in their classrooms, under the supervision of either the experimenter or a teacher. All of them seemed interested and cooperated willingly when the test was explained to them. The introductory statement on the test blanks read: "The questions in this booklet were given to some boys and girls in New York and some in California, to find out what boys and girls think and the things they wish for. We are giving it now to some Minnesota boys and girls to find out what they think and the things they wish for. There are no right or wrong answers. Each one will answer the questions differently. Just try to put down what you really think and really wish." Similar instructions were also given the subjects orally, and the fact impressed on them that the tests had nothing to do with school work.

The personality test consisted of three parts. Part one was a section from a Minnesota Interest Blank in which the subjects were either to select in order of desirability three wishes from a list of thirty-one presented, or to name their own.

Part two was a revision of the fourth part of Roger's Test of Personality Adjustment, and of eighteen questions from the Woodworth-Cady Test of Emotional Stability. The eight-point scale that Roger used was changed to a

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[1] From the Institute of Child Welfare, University of Minnesota.

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TABLE 1

NUMBER OF CHILDREN OF VARIOUS AGES IN THE TWO SCHOOLS WHO TOOK THE TESTS

Chronological Ages in Years	Faribault School for the Deaf			Owatonna School for Dependent Children			Both Schools		
	Boys	Girls	Both	Boys	Girls	Both	Boys	Girls	Both
13-13.9.......	4	3	7	4	2	6	8	5	13
14-14.9.......	4	3	7	3	6	9	7	9	16
15-15.9.......	5	6	11	8	7	15	13	13	26
16-16.9.......	3	12	15	7	7	14	10	19	29
17-17.9.......	2	4	6	2	10	12	4	14	18
18-18.9.......	7	4	11	1		1	8	4	12
Totals	25	32	57	25	32	57	50	64	114

three-point scale. The questions to be answered after each statement were "Am I just like her (or him)?" "Do I wish to be just like her (or him)?" The answers to be checked were either "Yes," "No," or "Sometimes." This method of checking provided a simple basis for comparing the results. The Woodworth-Cady questions were reworded to fit the indirect form of the Roger *questions, and the same three-point scale was used for them.*

Part three was the same as section five on the Roger Test of Personality Adjustment, except for the omission of questions 6, 8, and 18, which concern children's relations with their parents, and the addition of a question about the frequency and kinds of dreams the children had. A list of subjects known to be common in children's dreams--falling, eating, playing games, etc.--was followed by instructions to the subjects to add any other things they dreamed about and to "put X before the things you dream about sometimes, and XX before the things you dream about often."

The play interest blank, on which the subjects checked both the frequency and the desirability of participating in ninety different play activities, was the one used in the California study of gifted children.[2]

The items of the three parts of the test, except for the one concerning dreams, were classified under three general divisions: personal characteristics, individual's social adjustment, and individual's adjustment to the material environment. All the comparisons that follow are based on items for which the $\frac{\text{Diff.}}{\sigma\,\text{diff.}}$ between the rating of the deaf and that of the hearing children was greater than 2.

Personal Characteristics. Of the four items concerning fears, three were checked more often by the deaf than by the hearing children. More deaf than hearing children stated that they were afraid of fire and that they sometimes wished not to be afraid of being left alone in the dark. More hearing than deaf children said they never feared fire, though a considerable number of hearing children expressed occasional fear of being left alone in the dark.

There was some confusion apparent in the deaf children's answers to questions regarding emotional tone and attitude toward life. Many of them, for instance, appeared not to understand what was meant by the colloquial phrase, "getting a square deal from life," though a significantly greater number of deaf than of hearing children said they did not feel that they were getting "a square deal."

The deaf children's answers to questions relating to health indicated that they were in poorer health than the hearing children. Since no specific information on the health of either group was available, it is impossible to say whether this was actually so, or whether the deaf children's answers indicated a slight neurotic tendency in this group.

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[2] Terman, L. M., Genetic Studies of Genius, Vol. 1, p. 388.

More deaf than hearing children said they had no objection to doing what other people told them to do, whereas more hearing than deaf children said they sometimes did not want to do what they were told. This is in line with previous findings that deaf children are inclined to be more dependent than hearing children.

There was a slight, but scarcely significant, preponderance among the hearing children of the desire to "go away and have a lot of exciting adventures." The fact that this desire was less typical of the deaf than of the hearing is suggestive of the greater desire of the deaf for protection--a desire further suggested by the fact that more deaf than hearing children wished to be younger than they were. The narrow range of experience of the deaf may have prevented them from fully understanding what this item meant.

Social Adjustment. The only children who said they "did not care a bit whether people liked them or not" were seven deaf girls. A greater number of the deaf than of the hearing indicated that they wanted more friends than they had, while a greater number of the hearing than of the deaf said that they tried hard to make people like them. More of the deaf than of the hearing children said they did not get on well with their teachers, though more of the hearing than of the deaf expressed a desire to do better than they were doing in school. There was a greater tendency among the deaf than among the hearing to make the claim that they were "the brightest in school."

The deaf children showed a decided inclination to wish for isolation from social contacts. This might, of course, be expected, since their handicap makes social participation difficult.

Adjustment to Environment. In regard to material possessions, the hearing children appeared to be more satisfied with their clothes but more desirous of money than the deaf. At the school for the hearing children there is a large swimming pool and lessons are given the children--hence a smaller number of hearing than of deaf children expressed a wish to have swimming lessons. At the school for the deaf the children are encouraged to engage in Scouting, so that fewer deaf than hearing children said they wanted this type of activity. The smaller interest in dancing lessons among the deaf than among the hearing children may have been due to the difficulties attending this type of recreation for the deaf.

Dreams. The deaf children reported dreams about going on trips, or of visiting, to a significantly greater extent than the hearing children did. This type of dream is at variance with their expressed wishes, and may lend support to the theory that dreams are the expression of suppressed desires. More hearing than deaf children said they dreamed about movies, 'stories, and actors and actresses--a type of dream pretty much in accord with the usual interests of adolescents.

Play Interests. Comparison with previously published standards showed that, on the average, the institutionalized children were less mature in their play interests than children not living in institutions, and the deaf group were less mature than the hearing group. The hearing girls at the Owatonna school tended to be more masculine in their play interests than the deaf girls at Faribault.

CONCLUSIONS

The most characteristic difference between the two groups of institutionalized children was the tendency on the part of the deaf to withdraw from social participation and responsibilities. This tendency is shown in their desire to be younger and more dependent and to isolate themselves from social pastimes. The greater desire on the part of the deaf for more friends, as well as their inability to get on well with their teachers, suggest an insecure social adjustment. The less adequate emotional adjustment exhibited by the deaf also indicates their less satisfactory adaptation to adolescence.

Until studies similar to this one are repeated in a number of institutions, the differences noted between deaf and hearing children cannot be attributed unquestionably to the sensory handicap of the deaf, although the differences found by means of this study are all in line with those set forth in the literature. Further comparison of similar institutional groups with institutionalized sick or delinquent children would be of interest.

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THE RELATION OF REACTION TIME OF FIVE-YEAR-OLD CHILDREN TO VARIOUS FACTORS

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The reaction time experiment is so old that little needs to be said of it by way of introduction. Few psychological phenomena have been studied so frequently or in relation to so many factors. The purpose of the present research was to study the speed of reaction to an auditory stimulus by 5-1/2-year-old children, in relation to sex, occupational status, intelligence, reaction time of adults on the same kind of test, introversion or extroversion, and physical well-being.

Subjects were Minneapolis public school kindergarten children, 50 boys and 50 girls, aged from 5 years 5 months to 5 years 7 months; and 25 women having an average age of 22.9 years. The apparatus used was the Miles Reaction Board with accessory key, the main board being held by the experimenter and the extension placed before the child being tested. Each day's testing consisted of 25 trials divided into groups of 5 with a rest of 15 seconds between each group, this being increased to 30 seconds between the third and fourth groups. The child was allowed to watch the clock during preliminary trials while the test was explained to him, but this was not allowed during the real testing period.

Since the motor type of reaction is generally considered to be shorter than the sensory type, an attempt was made to keep the child's reaction muscular rather than sensory. He was frequently reminded to watch his finger and have it ready to press the key when the buzz came, while words like listen and hear were avoided. The children's reactions, however, were very likely mixed, some muscular and some sensory.

Odd-even correlations (Spearman-Brown corrections) were .952 for boys, .981 for girls, and .970 for adults. Test-retest coefficients for the children ranged from .781 to .901, for the adults from .597 to .809, and did not increase consistently from day to day.

Table 1 summarizes the results of the entire test. In the column labeled Q_3 are given the means of the 75th percentiles, in the column labeled Q_1 the means of the 25th percentiles. Our speediest adult mean of median scores for one day was 146 sigmas. This is slower than the average found in the literature, which is under 130. Perhaps the difference is due to the fact that all our adult subjects were females, whereas scores made in previous studies have shown a sex difference in favor of males. Moreover, giving the tests in groups of five, while it aided the children, may have had the opposite effect on the adults. The mean variation from 14 to 17 sigmas found for our adult subjects is comparable to or less than that recorded in the literature.

Reference to the table will show that our child subjects made a decided and continuous day-to-day betterment, whereas the gain made by the adults was very small and did not increase more than one sigma after the second day of the test. The uniformity of all scores increased with practice. No gain in uniformity was made by the adults after the fourth day, but the children were still gaining on the sixth. Girls on the sixth day of the test reached 55 per cent of the adults' speed. Every day after the second a few of the quicker children exceeded individual adult scores, and one boy almost equalled the mean adult score on his sixth day of testing.

Several previous investigations (1, 3, 5, 6, 10, 12, 13) have shown correlations ranging from .03 to .58 between reaction time and various measures of intelligence. Our conclusions in the present test are very similar to those of

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[1] From the Institute of Child Welfare, University of Minnesota.

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TABLE 1

REACTION TIME DATA (IN SIGMA UNITS)
FOR THREE GROUPS OF SUBJECTS IN SIX DAYS' TESTING

Day of Test	Individual Means					
	Q_3	Q_1	Median	SD	MV	SD of MV
			Boys (N = 50)			
1	241	302	267	34	42	18
2	223	272	245	26	35	11
3	205	251	226	23	32	11
4	201	244	222	25	30	10
5	191	233	212	22	28	7
6	191	226	208	22	25	6
Last 4 days	196	239	217	21	29	5
			Girls (N = 50)			
1	249	317	279	36	47	16
2	234	288	257	36	39	13
3	217	265	241	35	35	10
4	206	257	230	29	35	10
5	198	244	220	30	32	9
6	191	234	212	24	29	7
Last 4 days	202	251	226	28	33	5
			Adults (N = 28)			
1	142	168	154	13	17	6
2	137	160	147	15	16	5
3	137	161	148	9	15	4
4	139	160	149	11	14	5
5	136	157	146	11	14	3
6	136	159	147	12	14	4
Last 4 days	137	160	148	10	15	3

Tinker (14). We found correlations of .300 for boys and .117 for girls between median scores on the Detroit Kindergarten test and first-day reaction speed medians. In the case of the girls, however, this correlation was unreliable. The correlations increased with practice, reaching a maximum of .50 for boys on the fifth day and .30 for girls on the third day, but subsequently decreased again so that by the sixth day the correlations were .36 for boys and .12 for girls, i.e. they were similar to those of the first day.

Many previous studies of reaction speed have not considered sex differences, but when a comparison has been made (2, 3, 5) it seems to have been always in favor of males. The sex differences found among our child subjects in both speed and variability were very small and unreliable and were reduced almost to zero by the six days of practice, yet they were consistently in favor of the boys.

Included in this experiment were 25 children of each sex from the three lower socio-economic groups and an equal number from the three upper groups, the Goodenough-Anderson scale being used as a basis for classification.[2] For every test and for both boys and girls it was found that median scores of the two highest groups were better than median scores for the two lowest. The contingency coefficients for the six days were .566 for boys and .542 for girls. We may conclude, therefore, that children from the higher occupational groups appear to have a faster reaction speed than those from the lower groups.

There are several reports (4, 7, 8) of attempts to relate reaction speed to various physical conditions. Our findings showed low positive correlations between nutrition indices (calculated for the entire group of children) and physicians' ratings (available for 28 boys and 24 girls). Though these correlations were virtually all unreliable, their consistently positive character, plus the fact that comparatively large contingency coefficients were found, lead to the conclusion that there is a slight tendency for physical well-being to be related to speed of reaction.

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[2] Experimental Child Study, pp. 234-44.

Using the Marston Introversion-Extroversion Rating Scale (9), it was found that extroverted boys appeared to be speedier than introverted. Girls near the average on the extroversion-introversion scale were speedier than those at either extreme. For boys there was a mean correlation of .248 between speed of reaction and Marston's "energy" traits and of .205 between speed of reaction and Marston's "emotional" traits. For girls, however, corresponding correlations were virtually zero.

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THE SOCIAL DEVELOPMENT OF THE YOUNG CHILD

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It is my purpose in this contribution to try to give to parents and teachers some conception of the vivid and highly emotional drama in which their preschool children are each playing a leading role. Anna Freud has said: "Psychology will have achieved what education has a right to expect of it if, on the one hand, it describes the primitive nature of the child and, on the other hand, opens up new avenues for possible development and new techniques for the further expansion of the child's personality."

These children whose education is now so much in the forefront are not static, crystallized, already formed personalities. They are plastic, dynamic young individuals in a state of constant change, or better, growth. Patterns of behavior or symptoms present this month may have disappeared to be replaced by other patterns of behavior or symptoms next month. Each one of these behavior patterns, whether socially acceptable or not, has significance as an expression of the child's effort to solve the conflict between the demands of his own instinctive life and the demands of his social environment.

The aim of the nursery school and kindergarten teacher and the parent of today is to provide a setting for the preschool child where he can develop into a mature individual, whose instinctive needs are adequately satisfied and who, at the same time, is a socially responsible person. To put it in other words, we want our children to accept happily and without conflict the discipline which the community imposes on each of its members, in exchange for protection and social satisfactions.

When we observe the newborn human infant we realize first of all that he is the most helpless and dependent of creatures. Alone he cannot fulfill his simplest of needs, but in spite of his complete dependence on society, he remains for the first few months of his life a completely asocial being. His mother, on whom he is so dependent, is not for him a personality with whom he has a relationship. She is merely an extension of himself, with the sole function of assisting him in the attainment of his bodily needs, pleasures and comforts. For the first months, even year, of his life these bodily needs and pleasures are related to the taking in of nourishment and sucking. The child's first conflicts with his social environment are almost invariably related to his desire to gratify his impulse to suck. The pediatrician's rigid feeding schedule does not allow him to be fed whenever he wants to be fed. Nurses, grandmother, aunts and friends all bring pressure to bear not to let him suck his thumb or his toys. Very early the young child discovers that the adults upon whom he is so completely dependent are at war with him insofar as gratification of his bodily desires is concerned.

During the second year of his life the child again meets with considerable opposition from the adults of his environment. No longer is he allowed to wet and soil himself when and where he pleases. His mother is insistent that he become clean in his toilet habits and that he accept adult standards of what is nice and what is nasty, what is clean and what is dirty. Many things which the child during his second, third and fourth years discovers as sources of pleasant bodily sensations are forbidden him, often in threatening, frightening terms. He is told not to pick his nose, not to scratch his ear, not to make clucking noises with his tongue and particularly not to handle his genitalia or masturbate. His impulse to investigate everything within reach, to handle it and often to destroy it, meets with emphatic disapproval. "Mustn't touch that", "That's a no-no", "You can't have that because you will break it".

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[1] Psychiatrist, The New England Home for Little Wanderers, Boston, Massachusetts.

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When the child of three or four hits or knocks over a baby sister or brother who is now getting the loving attention he once had, - with none of the prohibitions he now has, - he is scolded or even severely punished.

The infant and the young child wants what he wants when he wants it and he uses every means at his disposal to get it. When frustrated in his effort to attain immediate satisfaction of his every want he resorts to outbursts of temper. However, in the course of his first six years and by the time he enters first grade at school, he has already learned to give up or renounce many of his wishes, and to accept postponed satisfaction of others. His sense of values has begun to shift from short-time to long-time satisfactions. But how has this shift in values taken place? Why does the child who was oriented only towards the attainment of his individual wants, now make room in his world for the wants of others? His aim is no longer merely for the immediate gratification of bodily needs, pleasures and comforts. The change has taken place because the child in the course of his development has discovered that those who originally merely catered to his wants and needs, can satisfy another growing instinct in him. They can love him and be loved by him. Being loved and being approved of becomes increasingly important to the small child. For the sake of holding the love of the grown-ups who care for him, he is willing to sacrifice the bodily pleasures which his love objects demand that he give up. His own individual gratifications are renounced in favor of love relationships to the people of his environment. Aggressive and hostile impulses directed against those who frustrated his attainment of immediate pleasure are replaced by feelings of tenderness and solicitude for these same people who have now become love objects. There is even tenderness for brothers and sisters in imitation of the attitude towards them of the parental love objects. Many of the child's former, purely selfish, bodily gratifications now obtain satisfaction in a changed or sublimated form which is socially acceptable. The child who formerly hammered for the physical joy of the activity and the pleasure in the sounds and sight of Daddy's cigarette box being smashed now hammers two boards together to make a boat.

In spite of all his renunciation and sacrifice and sublimation of his childish impulses the little boy or girl still cannot completely monopolize his much desired love objects. Mother belongs not only to him but also to Daddy and to brothers and sisters and to all sorts of outside interests. Daddy, too, much loved as he may be, cannot be dominated as the small child would like to dominate him. So, since the little child cannot make his parents his own in reality, he, so to speak, incorporates them into himself. That is, he adopts as part of his own personality and point of view their attitudes and their standards of behavior and morality. This new part of him is now at war or in conflict with the infantile, instinctive little creature that had as a sole aim, the immediate gratification of bodily pleasure.

Most children by the time they are 5, 6 or 7 have reached a beginning compromise within themselves between their instinctive demands and the demands of society as interpreted to them by their incorporated love objects or social conscience. The behavior patterns and symptoms of the small child are to be regarded as his successive efforts at finding a solution for his conflicts - between himself and his frustrating parents, between himself and his brothers and sisters, and finally between the older and new parts of his own personality. How successful the child will be in utilizing to the full his potentialities and native endowment is dependent on how successfully he succeeds in solving these conflicts common to all of mankind. His first 6 years is a vitally important period of his life and a determinant of his whole future. The child, as he grows up, repeats over and over in his relationship to people the patterns he has worked out as solutions to his conflicts at home.

As an illustration of this universal tendency to repeat, in adult life, patterns of behavior laid down in childhood let us consider a case history. For the sake of clarity I have selected material from the case of a girl who in childhood had to deal with emotional conflicts too great for her to solve by behavior patterns which would lead to mental and emotional health. In tracing the development of the sick or poorly adjusted personality, we can see in relief processes which are present in the well-adjusted and healthy but which do not stand out. In psychology, as in physiology, our perception of how and why functional patterns develop as they do is made clear by observation of pathological cases where too great weight or emphasis throws light on one or another dynamic process.

Case #1.

Mary is a housemaid of 24 years. She has never been able to hold a job for more than a few months because of her inability to get along with her employer or with other employees. She is a young woman of superior intelligence, as indicated by psychometric tests, as well as by her having succeeded in getting through high school against the odds of supporting herself from the time she was 15. She is attractive and is scrupulously neat and clean. Mary is a person who invariably succeeded in creating a favorable impression with the result that she never had any trouble in finding herself a position. For the first few weeks in any new job her work was always above criticism. During this period her employers had boundless enthusiasm for her and spoke of her sweet manner and gentle tactful handling of small children in the home. Then, as time went on, troubles began to pile up. If there were other maids in the household Mary began to accuse them of being lazy and irresponsible. She compared their inefficiency to her own painstaking work - which did not make her popular with cooks or nurses as the case might be. If anything went wrong in the house Mary felt that her mistress was blaming her unjustly. She became disturbed, not only about working relationships but also about the social relationships of her mistress and other employees. In one home she accused the adolescent daughter of her mistress of immoral sexual behavior. In another home she reported to her employer that the cook was "out all hours, doing goodness knows what". She intimated several times that her employer's husband or grownup son or guest was making improper advances to her. Coincident with this preoccupation concerning the working and social relationships in the household Mary's efficiency in her work diminished. When her employer spoke to her, even in a kindly way, about some carelessness she became sullen and seethed with inner wrath at what she regarded as an unjust accusation. She took all correction as an indication that her employer did not like her and wanted to be rid of her. It almost seemed that Mary then tried by her actions to provoke her mistress into having to dismiss her. When finally discharged she took a martyred satisfaction in her unhappy fate. It was her attitude that again she had been misunderstood, abused and rejected. On one occasion she lost a job because, after being called to task for some negligence in her work, she became irritated at her employer's 17 months' old child and slapped him.

Mary's pattern was to "sell herself" to a new employer as a superior person with idealistic strivings and some cultural ambitions. After being well-established in a position she became nervous, suspicious, resentful and accusing. She felt herself discriminated against and disliked by her mistress and she provoked rejection which proved to her that her suspicions and feelings that she was not wanted were justified.

The features of Mary's case reported above have roots in the emotional situations in which she found herself in her childhood. Now, in adult life, we see her repeating projections, rationalizations, self-justifications and defense mechanisms which in her childhood served her as solutions for conflicts between herself and her frustrating parents, between herself and her siblings and between the older and newer parts of her own personality. Space does not permit a complete reconstruction of Mary's childhood. However, a brief survey of her particular situation in her family will throw light on the unhappy, adult behavior patterns described above. We shall see that Mary's patterns developed early in life in response to her need to work out compromise after compromise between her inner self and the outer world with which she was confronted.

Mary was the second of three children. Her parents were never happy with each other and were both resentful of her birth which followed 11 months after the birth of Betty, the older sister. From the beginning Betty was the favorite of both the father and mother. When Mary was 3 her brother was born and it seems possible that her accusations are true that he was the child of another man than her father. Mary was bitterly jealous of this baby boy, whose birth deprived her of whatever advantage she had had as the baby in relation to her mother. The baby brother died while still in infancy. It is significant that following his death, Mary's favorite form of play - which had a compulsive character - was to "kill" her dolls and bury them. She developed anxiety about being alone in the dark or in closed places - an apprehension which has remained with her up to the present time. From the ages of about 4 to 7 she suffered from night terrors and in adolescence she began having frequent anxiety dreams which have persisted. In the course of studying her it became apparent that Mary's hostility for the baby brother had been so great that she had wished him to die. His death in reality had come as a gratification of her wish and her deep reaction was: "I wished my brother's death. My wish has killed him so I am guilty and I'll be punished." From the age of 5 or 6 on Mary became increasingly solicitous and protective of small children, as a defense against or reaction to her dangerously hostile wishes towards young usurpers of a mother's love. In the episode of her angry slapping of her mistress' 17-months-old son, following a rebuke which she took to be a rejection, Mary's old hostile impulses succeeded in breaking through her defenses against them.

In childhood Betty was held up to Mary by her mother as an example. Betty seemed always to be right and Mary always wrong. As a matter of course, new clothes went to Betty to be handed down to Mary. Early in life Mary began to try to create new situations in which she could be the favored one and could escape her unbearable position at home. She went to her grandmother or to neighbors to bask in the attention and admiration her precocious manner won for her. To offset Betty's success in the family situation, Mary threw herself into school life with enthusiasm and struggled to hold the place of teacher's pet. It became her ambition to be a teacher when she grew up. Betty, never a success in school, was looked upon as inferior by Mary. As time went on Mary became more and more resentful that Betty, who was "dumb and lazy", was still the favorite of the family. She considered that both parents discriminated against her - the clever and ambitious child - in favor of her good-for-nothing older sister. In puberty Betty showed strong heterosexual interests and was popular with the village boys. Mary was jealous but defended herself by looking down on Betty, just as she now scorned her mother. She regarded them both as frivolous and immoral. She became increasingly disagreeable at home and openly accused her mother of failing in her duties and of setting a poor example for her daughters. Her mother, in desperation, took the attitude, "Well, if you don't like me why not go and live somewhere else." Mary took her mother at the face value she herself had provoked and with resentment she left home and obtained her first job as a mother's helper. She firmly believed that, through no fault of her own, she had been put out of her home and permanently rejected.

This outline of Mary's childhood reactions to her family background shows obvious parallels to her subsequent life trends. Over and over again as an adult she got herself into situations in which she could carry on the battles of her childhood. Her social relationships in each new environment inevitably took on the color of her childhood relationships. Competition in work always remobilized her old competition with her sister. The slightest rebuke from her employer reawakened her feelings of frustration and rejection by her mother. Her reactions to new people and events became almost photographic reproductions of earlier reactions to people and events at home. Mary continued to try to reach a compromise between the older and newer parts of her personality in symptoms such as her fear of small enclosed places, her bad dreams and her outbursts of aggression, as well as in other symptoms not gone into in this report.

Having seen of what far-reaching significance are the events and relationships of the child's first 6 years, we come now to the task of education - *which is the function of the home, supplemented by the kindergarten after the* child has begun to master the first rules of social life. This preschool education is not the formal presentation of factual information which the child will encounter later on in the grades but is rather a matter of allowing and forbidding, encouraging and discouraging the child's gratifications of his primitive, instinctive impulses. If he is allowed too complete or too frequent gratification of his infantile asocial wishes, he remains satisfied with life at a primitive, childish level. He is fixated at what should have been merely a passing phase in his development. His satisfaction is so great that he has no strong motivation for proceeding with the drama of his emotional development. It is this child who has been allowed too complete instinctual gratification who, in later years, is apt to fall into the category of delinquency or perversion.

Case #2.

Sidney, a 12-year-old boy, was referred to the New England Home for Little Wanderers by a school truant officer. Though of good average intelligence and free from specialized learning disabilities Sidney was not progressing in school and apparently he did not care. His tendency, according to his teachers, and to all who knew him, was to lie down on every job assigned him that made any demands upon him. He was unable to accept even a minimum of work and whenever he felt that things were not going as he wished, he became sulky and refused to cooperate further with the social group. He, as it were, took flight from a situation that did not cater to his every whim. Sidney was absent from school more days than he attended but always he was able to bring a note from his grandmother attesting to the fact that he had been at home, sick in bed. His obvious robust good health belied this excuse of frequent illness. It was reported in the neighborhood that Sidney was sometimes seen out fishing or wandering about the hills nearby during school hours.

Sidney was suspected of being responsible for some petty thievery. He had a habit of "borrowing" bicycles without the knowledge or consent of the owners. The truant officer was assigned the task of checking up on Sidney's activities. When he called at Sidney's home Sidney was not there. His stepmother said, in a resigned voice: "Well, I thought he was at school but if he is not you'd better look for him over the hill at his grandmother's." She went on to say that she had given up trying to do anything with Sidney, that though he was supposed to live at home with her and with his father, he spent much more than half his time with his grandmother. "She's got him so spoiled he's not good for anything." The truant officer went on to the grandmother's cottage where he found Sidney in bed, surrounded by comforts and good things to eat. He was basking in the solicitude of his grandmother.

Sidney's story is almost a caricature of the pampered child. His own mother died at the time of his birth. He and his father were taken into the home of his dead mother's mother. His grandmother, a lonely woman, who had had no son of her own, lavished all her love and vast energy on little Sidney. Her whole aim seemed to be to protect him from any thwarting or frustration. She over-fed him and over-coddled him. His slightest wish or need received her undivided attention. Sidney had no motivation for applying himself to anything except receiving gratification and adulation without the expenditure of any effort. His first 6 years were spent in this hothouse environment. His father then remarried and brought his new wife into the home. She soon found the situation impossible, so they moved to a home of their own, supposedly taking

Sidney with them. The stepmother did her best to help Sidney stand on his own feet and take some responsibility. Sidney could not accept the privation entailed by responsibility; so, what his stepmother would not give him he took or went back over the hill to his grandmother where things again were easy for him. But his grandmother could not possibly keep up with the imperious demands of this growing boy. All she could do was to try to protect him from the consequences of his anti-social acts. His behavior was based on his philosophy that the world was his by right and that there existed no authority superior to himself.

One can see in this boy's present reactions the pattern of an unhappy, constantly frustrated future unless something interferes to break down the vicious circle. The danger is that as a grown-up man Sidney will try ineffectually but over and over again to recreate the childhood situation of gratification of every impulse. His childhood prepared him to meet only that one infantile condition of life. Sidney had no need to exert himself to hold his grandmother's (mother's) love and there was no motivation for sublimation of his impulses.

On the other hand, a child who has been forbidden too much or who has too early been forced to conform to adult standards, runs the risk of later showing neurotic traits, ranging from simple inhibitions in behavior to a diversity of psychoneurotic symptoms. This child has had to put aside or repress his unsatisfied impulses. He has had to do this before he was able to sublimate them into useful, creative activity from which he could get a substitute satisfaction.

Case #3.

Douglas, a 10-year-old boy, was referred to the New England Home for Little Wanderers by his school principal. His teachers had been puzzled by his adjustment ever since he began coming to school. He was an attractive, bright child, with unusually pleasing manners. His good behavior and extreme neatness made him a favorite of all the adults with whom he came in contact. But he was totally unable to get along with other children. Even the girls regarded him as a "goody-goody" or a "sissy", and he was the butt of many a joke. He at first struggled valiantly but pathetically to win himself social standing. He brought flowers and candy to his teachers and he tried to introduce dramatizations of history stories to his playmates as a playground occupation. The ridicule of his contemporaries soon caused Douglas to withdraw into himself. He became progressively more isolated from the group and sought his satisfactions in imaginative play by himself. While occupied with something else his fingers were often in his mouth. He developed some facial tics, accompanied by sucking noises. His school teachers were particularly concerned by his failure to learn. His first two years of school had given promise of considerable academic success but, just as he withdrew energy from forming social relationships, energy was also withdrawn from his studies. Douglas continued to struggle with his lessons. He tried desperately hard to bring in perfect arithmetic papers and to spell correctly all the words given but what he learned he forgot, what he knew he seemed unable to reproduce and his anxious struggle for perfection interfered with his concentration.

Douglas was an obviously inhibited, disturbed little boy who showed what might be the beginning of severe neurotic symptoms or even of a psychosis.

Douglas was the second child of a middle-aged couple. His older brother had died at six years several years before the birth of Douglas. Both his father and mother were ambitious, conscientious people, eager to pull themselves into a higher economic strata than that into which they were born. The father s business kept him away from home much of the time so that his contact with the boy was slight. When with Douglas he was given to quizzing him on his school progress and to delivering moralistic talks on the virtue of hard work, courage and good sportmanship. He advised his son not to waste time on idle play and he tried to institute a Spartan regime as a preparation for the struggle to climb the ladder of success.

The boy's mother was an independent, self-reliant person, active in community affairs. She was an efficient and meticulous housekeeper and managed to supplement the family income by selling home-made bread, cakes and pies to a local restaurant. Before her marriage she had had some nurse's training and she considered herself an authority on the upbringing of children. She read a great deal and, whenever possible, took courses on home management and child care. Douglas' infancy was strictly aseptic. He was fed stipulated quantities by the clock. When he sucked his thumb his elbows were put in splint to keep his hands away from his mouth. He was trained in toilet habits before the age of 10 months and his infantile masturbation was promptly checked. As Douglas grew older he was an unusually amenable, passive child. His only striving was to please his parents who were so rigid in their demands on him. By the time he reached school he had need of perfection in himself in order to be free from anxiety and tension. But his personality growth was inhibited by the strict regime instituted by his love objects and carried on in him by his intolerant conscience.

It is the difficult task of parents, nurses and teachers to allow and, at the same time, forbid so that instinctual impulses are neither allowed too full expression or too complete denial. Mental health and mature adjustment are to be reached by a path midway between allowing and forbidding. Our aim for the unsocial, instinctual impulses is that they should be sublimated into creative or useful activity. Let us consider an example of this process of sublimation which is so important and satisfactory a means of meeting the demands of the environment without giving up the possibility of gratification of instinctual demands.

Case #4.

Jerry is a 12-year-old boy of average intelligence and of a relatively pleasing personality. He is a hard worker and, if interested in what he is doing, he works with concentration and enthusiasm. His outstanding interest is in things that are mechanical. Although he has no mathematical ability or particular manual skill, he is fascinated by engines, appliances and machinery. He takes a keen delight, not only in taking things apart but also in putting them together again so that they will work. "I like to know how things work the way they do and when I build something it works - it isn't just for looks." Jerry was willing to go to no end of trouble to find out how things were built, how they worked and how to build them himself. His room was more of a shop than a bedroom. It contained a model railroad system, a model airport, bridges that would bear weight and derricks that would lift loads. His homemade radio was the delight of his heart. Jerry's stepfather owned a second-hand car and Jerry missed no opportunity of tinkering with it. His activity with it, when his stepfather first got it, was largely of a destructive sort but his stepfather, a man of wisdom, patience and some mechanical ability himself, helped and encouraged Jerry in putting it together better than it was before. His stepfather took pains to teach Jerry to drive the car and promised him the use of it "as soon as the law allows".

Jerry was an only child whose father died shortly after his birth. When he was 4 his mother remarried and within the next year she had two miscarriages. During the interval between his father's death and his mother's second marriage, Jerry slept in a cot in his mother's room. When the stepfather entered the home Jerry was given a room of his own and his mother and stepfather slept together. For almost two years after the mother's marriage Jerry showed temper tantrums and outbursts of aggressive destructive behavior. He showed a tendency to rummage through drawers and boxes and there were scattered episodes of stealing. His mother complained at that time of his tendency to "snoop around". He was a trial to everyone because of his constant and repetitive asking of silly questions, many of which he knew the answers to.

Jerry's psychological situation following his mother's marriage was a difficult one. To him his stepfather represented a dangerous intruder who not only interfered with his own relationship to his mother but even, it seemed to him, hurt his mother and made her bleed. He did not know what went on in the bedroom from which he was carefully excluded but he was consumed with curiosity and apprehension about it.

When Jerry was 5 his mother in desperation sent him to kindergarten. From the beginning he liked it and his teacher was really fond of him, in spite of the difficulties he presented. At kindergarten he was allowed to build block towers, knock them down and build them again. He was allowed to explore the cupboards in which materials were kept and his teacher encouraged him and taught him to use whatever caught his interest. He worked with clay and paint and finally with wood and tools.

Jerry's stepfather, a big, robust man who was an expert carpenter, became as time went on not only an object of fear but also of envy and admiration. His instinctive handling of the boy was wise and Jerry, in order to hold his mother's love and win his stepfather's admiration, gradually gave up his anti-social tendencies. His mechanical interests now are not only evidences of his old identification with his stepfather but are also sublimations. In his curiosity as to how things work he can inquire into and find satisfaction for what, earlier in life, had been forbidden sexual curiosity. In taking machinery apart he can satisfy his old hostile and destructive longings. In building things that will work he can assure himself that he, too, will someday be strong and powerful, like his stepfather. Jerry's sublimations have absorbed the energy that might, under less fortunate home and school circumstances, have produced unhappy, delinquent behavior.

It is, first of all, the parents who provide the motivation for this sublimation because of the child's love relationships within his family circle. The nursery school and kindergarten provide a stage where the child in a secure, protected environment can try himself out apart from the people to whom he is so closely tied emotionally and with whom he is in such conflict. In the nursery school, for the first time, he meets life standing on his own two feet. He, of course, brings to school with him his conflicts from at home but here he can for a while try to work them out undisturbed by the objects of his love, fear and envy. The nursery school and kindergarten offer to the child materials and further incentive for the attainment of the sublimation motivated at home. It gives sympathetic help to the child's acquiring of skills into which his energy can flow. It brings new people into his horizon so that his intense feelings towards the people at home can be somewhat mitigated by interests in the large community.

This account of the stormy evolution of the child into a social being which occurs during his first 6 years does not answer individual questions of what to do about particular problems but to answer such individual questions one must know both the child and the parents and the whole life situation to which the child has had to adjust.

Present day parents and teachers bombarded by all sorts of modern, child-training literature and speeches, are apt to become panicky. Parents are told repeatedly that they are responsible for their children's future mental health and their first impulse is to do something about it. In their eagerness to be good parents they feel that they must be active to combat the dangers that may lie in wait for their children or, following the ideas laid down by Rousseau, they avoid all prohibition, all authority, for fear they may limit their children's individual development. In either case they become self-conscious, doubting parents or self-conscious teachers but the child in his own uncertainty and doubt has need of love objects with whom to identify, who have assurance and firmness in their philosophy and a tolerance born of a happy solution of their own infantile conflicts.

CHANGES IN THE STATURE AND SITTING HEIGHT OF PRESCHOOL CHILDREN IN RELATION TO REST IN THE RECUMBENT POSITION AND ACTIVITY FOLLOWING REST

JANET E. REDFIELD AND HOWARD V. MEREDITH[1]

The study to be reported in this paper had its setting in a practical question of laboratory procedure. The question was: Does an afternoon rest period elicit a change in the stature and sitting height of children of preschool age which is sufficient to necessitate that repeated measurements of the same children at bimonthly or quarterly intervals be made with direct reference to the rest period? In other words, are there changes brought about by rest in the recumbent position which are great enough to affect the comparability of seriatim measurements on a given child where examinations are made before the rest period on some occasions, immediately after the rest period on other occasions, and at various times during the first hour following the termination of the rest period on still other occasions?

The specific aims of the study may be listed as follows:

1. To determine whether children of preschool age show significant gains in stature and sitting height during an afternoon rest period
2. To investigate the amount of loss in stature and sitting height which takes place during the first one-half hour and first hour after the rest period
3. To study gain in stature and sitting height during rest (if appreciable gain is found to occur) in relation to duration of rest period and degree of relaxation
4. To determine if loss in stature during the first hour following rest is greater under vigorous physical activity than under slight or moderate activity

LITERATURE

It has long been known that stature, and certain other linear dimensions that may be considered segments of stature, are subject to diurnal fluctuation. The research literature on this phenomenon dates back more than one and a half centuries and includes studies by Montbeillard (5, 8), Merkel (1), Bradford (2), Malling-Hanson (5), Wiener (1), Curtiss (3), Yamada (1), Poniatowski (1), Bachman (1), Hohlfeld (1), Palmer (6, 7), and Davenport, Steggerda, and Drager (4).

In 1776 Montbeillard secured measurements on his seventeen-year-old son and found that "stature tends to decrease during the day and with prolonged exertion, and that this loss is regained with rest." (8, p. 333) He is reputed to have observed that on one occasion of unusually prolonged exertion and assumption of the erect position, "when his son had danced all night,...height had decreased by 38 mm. but after 24 hours' rest the loss was recovered."(5, p.2)

"Merkel (1881) measured his own daily linear reduction in both the sitting and erect posture from the time of rising in the morning until going to bed. He had an apparatus constructed whereby he measured the height of the visual plane from the floor, the 'Augenhöhe.' His sample day, after being up six hours, showed a decrease in 'Augenhöhe' while standing of 2.0 cm. and, while sitting, of 1.6 cm. Of this decrease 0.8 cm. and 0.6 cm., respectively, or

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[1] From Iowa Child Welfare Research Station, State University of Iowa, Iowa City, Iowa.

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about one-half, took place in the first hour. After a two-hour period of rest reclining, there was a partial return toward the morning reading of about 1 cm. in both measurements, with a subsequent decrease comparable to that seen in the morning." (1, p. 394-395)

Bradford (1883) measured the stature of a single adult, aged thirty-five years, in both the erect and recumbent positions. Measurements were obtained at 7 a.m. and at 10 p.m. The findings were similar for both positions. To quote Bradford directly: "...the height of the same individual is greater in the morning than in the evening....A person is larger in the recumbent position in the morning than in the same position at night." (2, p. 246)

Malling-Hanson (1886) published a study based on approximately seventy boys of school age measured daily over a period of two years. The study incorporated the following finding on daily variation in stature: "...from the time the boys got up in the morning till the time they went to bed at night their height declined by about 1 cm., which loss was regained by the next morning." (5, p. 5)

Wiener (1896) investigated "daily decrease in height for two of his four sons." (1, p. 395) His tables show "a decrease of 0.8 and 0.9 cm. in the first hour, a partial return after a nap, and a total daily loss of 1.3 and 1.9 cm." (1, p. 395)

Curtiss (1898) made a study of change in stature during sleep using three male students (aged seventeen, nineteen, and twenty-one years) in attendance at Purdue University. The subjects were measured "just before going to bed at night and as soon as they got up in the morning, the hours being approximately 10 p.m. and 6:30 a.m." (3, p. 270) Daily records were obtained for a period of approximately six months, i.e. January through June. For the subject aged seventeen years, the average gain in stature during sleep was 16.4 mm., and the range in gain from 9 mm. to 24 mm. The findings for the other two subjects were similar. Thus, "The total average gain in height for all three was 18.22 mm." (3, p. 273) Supplementary mention was made of the fact that all three subjects took regular gymnasium work and that "On the days when they had worked especially hard in the gymnasium or field it was noticed that...the gain in height was somewhat greater." (3, p. 271) Curtiss recommended that anthropometrists note the hour at which individuals are examined and arrange for subsequent examinations "at the same hour, or as near it as possible." (3, p. 273)

The studies by Yamada, Poniatowski, Bachman, and Hohlfeld have been reviewed by Boyd (1). As for the studies by Merkel and by Weiner, it will suffice to reproduce her treatment.

"Yamada (1902) noted a daily decrease in stature in the Japanese. The available references are ambiguous as to amount.

"Poniatowski (1911) states that a daily decrease in body length of 2 to 3 cm. is well known and '...so scheint es zwecklos, die Korpergrosse genauer als bis auf +0.5 cm. zu messen.'

"Bachman (1924), in an extensive statistical analysis of the daily shrinkage in standing height for 200 men, finds a decrease of 0.76 cm. one hour after rising, 1.77 cm. four hours after rising, 2.17 cm. seven hours after rising, and 2.36 cm. eleven hours after rising. He has also developed analytical expressions for both the daily decrease in stature and the nightly recovery.

"Hohlfeld (1920) noted that infants from six to thirteen months of age showed an average decrease in body length of 0.05 cm. after sitting up one hour, and 1.12 cm. after standing one hour. One infant, measured after sitting up two and one-half hours, showed only a 0.03 cm. decrease in the second hour." (1, p. 395)

Palmer (1930) obtained stature measurements on three preschool children at approximately hourly intervals during the day for a period of from three to five consecutive days. He found that during the first hour after arising stature decreased approximately 7.0 mm., during the second hour approximately 3.5 mm., during the third hour approximately 2.5 mm., and during the fourth hour approximately 2.0 mm. Beyond this average reduction of about 1.5 cm. for the first four hours after assumption of the erect position, he found children "two to five years old" to "decrease about 2 cm. in standing height from morning to night...." (1, p. 396)

In addition to the above data on the general trend of daily decrease, Palmer reported incidental findings on the rate of reduction in relation to physical activity, and on increase in stature accompanying a midafternoon nap. His published treatment of these two problems, unfortunately, is restricted to the following statements: "Children who exercise vigorously in the first hour after arising may lose one-half inch in total stature. Children who have a mid-afternoon nap gain back about half the height lost during the earlier part of the day." (7, p. 9)

It is Palmer's view that loss in stature "is associated definitely with the assumption of the erect posture" and regain in stature "is associated with rest in the recumbent position." (7, p. 8) He further mentions the probability that "variations in the thickness of the intervertebral discs and in the apposition of the bones of the leg and foot account for the major part of the diurnal variation." (7, p. c)

Davenport, Steggerda, and Drager (1934) reported a study of reduction in linear dimensions of the body from morning to afternoon. One anthropometrist (M.S.) measured a single subject "fifty consecutive times at different times of the day through a number of days." (4, p. 266) Measurements of stature, supersternale height, sitting height, and sitting supersternale height were taken. The measurements "were all made from 2 to 8 hours after rising in the morning...." (4, p. 271) They were grouped into a.m. observations and p.m. observations. The two groups represented an interval of "probably not more than 6 hours...." (4, p. 271) It was found that the average loss from morning to afternoon was 7.4 mm. for stature, 6.5 mm. for supersternale height, 9.2 mm. for sitting height, and 7.6 mm. for sitting supersternale height. In discussing the findings for stature and sitting height the authors state, "It might seem remarkable that the loss should be the greater in the sitting height (involved as it is in stature). But anyone who has had extensive experience in measuring sitting height knows that the act of sitting, as contrasted with standing, brings quite new muscles to play upon the posture of the trunk and demands special control of, and tone in, those muscles. For we are habituated to erect standing and to a slumping sitting posture. The loss of stature during the day is probably quite as much due to loss of 'tone' as of thickness of intervertebral pads." (4, p. 270-271)

SUBJECTS

The subjects for the present study were twenty-two children between four and five years of age. They were all of the children in attendance at Group III of the Iowa Child Welfare Research Station preschools during the spring months of 1938. This group met between one and five o'clock in the afternoon.

In accordance with the program being followed in the group, half of the children rested between the hours of one and three o'clock and the other half between the hours of three and about four-thirty. For purposes of this study it was possible to examine the children of the former group four times in the course of the afternoon and the children of the latter group twice. Specifically, the children of the group that rested from one to three o'clock were examined just before going to the sleeping room, immediately upon rising, one-half hour later, and one hour after rising. The children in the second group were examined just before going to rest and immediately upon rising.

MEASUREMENT PROCEDURE

Determinations of stature and sitting height were made by the following anthropometric technique:

Stature

Instrument: Baldwin Paper Measuring Scale and Square

Definition of Measurement: Erect body length from the soles of the feet to the vertex

Landmark: Vertex -- the highest point of the head when held with the tragion-orbitale plane parallel to the floor

Posture: The subject stood erect with heels almost touching each other. Heels, buttocks, upper part of back and rear of head were in contact with the wall to which the scale was attached. The arms were permitted to hang at the sides in a natural manner.

Technique: When the subject was in position, the anthropometrist took the square and placed it above the subject's head so that its one face was against the scale and its other face horizontal with the floor. The square was then brought down until the horizontal face crushed the subject's hair and made firm contact with the vertex. Care was taken to see that the subject kept his heels in firm contact with the floor.

Sitting Height

Instrument: Baldwin Paper Measuring Scale, Square, and a horizontal walnut bench 30 cms. in height

Definition of Measurement: Distance from the surface of the bench to the vertex with the subject in an erect sitting position

Posture: The subject sat on the bench with his knees flexed and spread apart, his ankles crossed, hands resting on his thighs, and the posterior aspect of his trunk in contact with the scale both at the sacral region and at the upper thoracic region. Always after the knees of the subject had been spread apart and his ankles crossed (in order to release as much as possible the tension of the gluteal muscles and to permit the ischia closely to approximate contact with the bench) the anthropometrist checked to see that the sacral region was in contact with the scale.

Technique: The Square was brought down firmly on the vertex as in measurement of stature, and the sitting height recorded as the value read from the scale minus the height of the bench.

Each time a child was examined three independent measurements each for stature and sitting height were obtained. In the case of stature, for example, after the first reading was taken the child was removed from his position in front of the scale and entirely replaced for a second reading. He was then again removed and replaced for a third reading. The median of the three readings was taken as the stature record for the examination. A sitting height value for each examination was obtained in the same manner.

Three or four children from each rest group, making a total of seven or eight in all, were as many as could conveniently be measured in any one afternoon.[2] Consequently, collection of the data covered a number of days.

Because of the limited number of subjects available, from one to four series of observations were made on each child. No selective factors, other than that of availability on the days that collection of the data was in progress, operated to restrict a few children to one series of observations while a few others received four series of observations.

GAIN DURING REST

A total of forty-five examinations were made just prior to rest and again immediately following rest. These examinations made it possible to compute, for each of forty-five cases, the difference between stature before rest and stature after rest and the difference between sitting height before and after rest.

Forty-five cases were accumulated by using all of the twenty-two subjects once, fifteen of the subjects twice, six of the subjects three times, and two of the subjects four times. The duration of the rest period ranged from one to two and one-half hours, with most of the subjects resting about one and three-fourths hours. Rest took place in an appropriately equipped sleeping room with the child recumbent on a bed.

The two series of differences were computed as stature after rest minus stature before rest, and sitting height after rest minus sitting height before rest. Consequently, positive values were indicative of gains during rest. Distribution and analysis of the differences obtained, specific for each measurement, gave the following tabulation.

Statute

Gain, Millimeters	Number	Per Cent
0 to 2	2	4.4
3 to 5	6	13.3
6 to 8	12	26.7
9 to 11	12	26.7
12 to 14	9	20.0
15 to 17	1	2.2
18 to 20	2	4.4
21 to 23	1	2.2
Total	45	99.9

Mean gain = 9.3 mm.
Range = 0 to 21 mm.

Sitting Height

Gain, Millimeters	Number	Per Cent
- 4 to - 1	5	11.1
0 to 3	5	11.1
4 to 7	14	31.1
8 to 11	13	28.9
12 to 15	4	8.9
16 to 19	2	4.4
20 to 23	2	4.4
	45	99.9

Mean gain = 7.7 mm.
Range = -4 to 23 mm.

The findings from this tabulation are:

1. The mean gain in stature of four-year-old children during an afternoon rest period of approximately one and three-fourths hours duration is 9.3 mm. The corresponding mean gain found for sitting height is 7.7 mm., or 83 per cent of that for stature.
2. Eighty-two per cent of the cases show stature gains greater than 5 mm., or one-fifth inch. Sitting height gains of 4 mm. and higher are obtained for 70 per cent of the cases.
3. The range for stature is from no gain in one instance to a gain of 21 mm. The child showing a gain of 21 mm. served as a

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[2] The writers wish to acknowledge their gratitude to Miss Eleanor Lack, head teacher of Group III, for her interest in the study, for the splendid manner in which she introduced the study to the children, and for her cooperation in facilitating collection of the data.

subject two other days. On all three occasions the rest period approximated two hours and the child was asleep for somewhat more than one hour. The gains on the other days were 10 mm. and 8 mm., respectively. The child showing no gain served as a subject on one other day. The gain on this second occasion was 7 mm. On neither occasion did the child sleep. The gain of 7 mm. was associated with a rest period of one and one-half hours duration. The "no gain" record was obtained for a rest period of one hour, during which the child was observed to be exceptionally restless.

4. For sitting height the range is from a loss of 4 mm. to a gain of 23 mm. The greater variability of the findings here is undoubtedly due to the relative unreliability of sitting height measurements.

GAIN DURING REST IN RELATION TO SLEEP

In order to obtain an indication of the influence of "degree of relaxation and duration of rest period" on the gain in stature and sitting height during rest, the data presented in the previous section were subdivided. The subdivision was made on the basis of whether the cases did or did not sleep -- the assumption being that the degree of relaxation is greater for a group of children who sleep during rest than for a group who do not sleep. As one would expect, the cases that slept tended to have longer rest periods than those staying awake. Specifically, the mean duration of the rest period was 2 hours, 5 minutes for the sleep group and 1 hour, 20 minutes for the nonsleep group. The range in duration was from 1-1/2 hours to 2-1/2 hours for the former group and from 1 to 2 hours for the latter group.

Twenty-seven of the forty-five cases fell in the sleep group and the remaining eighteen in the nonsleep group. The amount of sleep per case for the members of the sleep group varied between 1 hour and 1-3/4 hours. Statistical reduction of the data for each group paralleled that for the total cases reported above. The following tabulation gives the results.

Gain, Millimeters	Sleep Group		Nonsleep Group	
	Number	Per Cent	Number	Per Cent
		Stature		
0 to 2			2	11.2
3 to 5	1	3.7	5	27.8
6 to 8	4	14.8	8	44.4
9 to 11	9	33.3	3	16.7
12 to 14	9	33.3		
15 to 17	1	3.7		
18 to 20	2	7.4		
21 to 23	1	3.7		
Total	27	99.9	18	100.1
Mean gain = 11.7 mm. Range = 5 to 21 mm.			Mean gain = 5.7 mm. Range = 0 to 10 mm.	
		Sitting Height		
- 4 to - 1			5	27.8
0 to 3	3	11.1	2	11.1
4 to 7	6	22.2	6	33.3
8 to 11	8	29.6	4	22.2
12 to 15	6	22.2	1	5.6
16 to 19	2	7.4		
20 to 23	2	7.4		
Total	27	99.9	18	100.0
Mean gain = 10.1 mm. Range = 0 to 23 mm.			Mean gain = 4.2 mm. Range = -4 to 13 mm.	

It is found that for children four years of age:

1. The mean gain in stature during an afternoon rest period of two hours duration, where the children spend roughly one and one-fourth of the two hours in sleep, is 11.7 mm. or, practically, one-half inch. The corresponding mean gain for sitting height is 10.1 mm., or 86 per cent of that for stature.
2. The mean gain in stature for the nonsleep group (i.e., group having a rest period of approximately one and one-fourth hours though not sleeping) is 5.7 mm., or less than one-half that of the sleep group. Likewise the mean gain in sitting height for the nonsleep group is less than one-half that for the sleep group.
3. Over 80 per cent of the cases in the sleep group show stature gains in excess of 8 mm., or one-third of an inch. In contrast, a similar percentage of the cases in the nonsleep group show stature gains of less than a third of an inch.
4. Sitting height gains of 8 mm. or more are obtained for approximately 67 per cent of the sleep group and 28 per cent of the nonsleep group.
5. For stature, the range is from zero gain to a gain of 10 mm. in the case of the nonsleep group, and, in the case of the sleep group, from a gain of 5 mm. to a gain of 21 mm. For sitting height, the range of the nonsleep group is from a loss of 4 mm. to a gain of 13 mm., while the range of the sleep group is from zero gain to a gain of 23 mm.

LOSS DURING FIRST HOUR FOLLOWING REST

For the subjects resting between approximately one and three o'clock, it was possible to make two series of examinations subsequent to that made immediately following rest. Consequently, twenty-two cases (involving ten different subjects) were examined at thirty minutes, and again at one hour, after the rest period. All twenty-two cases slept during rest. The mean duration of the rest period was roughly 2 hours, and the mean duration of sleep 1-1/4 hours.

With the aid of these data and the data obtained immediately following rest, differences for each case were calculated between stature after rest and stature one-half hour later, sitting height after rest and sitting height one-half hour later, stature after rest and stature one hour later, and sitting height after rest and sitting height one hour later.

The two series of differences analyzed in the following tabulation were computed as stature immediately after rest minus stature one hour later, and sitting height immediately after rest minus sitting height one hour later.

Stature

Loss, Millimeters	Number	Per Cent
0 to 2	1	4.5
3 to 5	2	9.1
6 to 8	8	36.4
9 to 11	4	18.2
12 to 14	6	27.3
15 to 17	1	4.5
Total	22	100.0

Mean loss = 8.2 mm.
Range = 1 to 15 mm.

Sitting Height

Loss, Millimeters	Number	Per Cent
-12 to - 9	1	4.5
- 8 to - 5		
- 4 to - 1	1	4.5
0 to 3	4	18.2
4 to 7	7	31.8
8 to 11	3	13.7
12 to 15	3	13.7
16 to 19	2	9.1
20 to 23	1	4.5
	22	100.0

Mean loss = 6.8 mm.
Range = -10 to 20 mm.

This tabulation yields the following findings:

1. Mean loss in stature of four-year-old children during the first hour following an afternoon rest period of approximately two hours duration is 8.2 mm. The concomitant mean loss in sitting height is 6.8 mm., or 83 per cent of the loss for stature.
2. Eighty-six per cent of the cases show losses in stature greater than 5 mm., or one-fifth of an inch. Sitting height losses of 4 mm. or higher are obtained for 73 per cent of the cases.
3. The range of loss in stature is from 1 to 15 mm. For sitting height, the corresponding range extends from a gain of 10 mm. to a loss of 20 mm.
4. The mean loss in stature during the first hour following rest (8.2 mm.) is equivalent to 70 per cent of the mean gain obtained during rest for the sleep group (11.7 mm.).

Analysis of the data on loss in stature and sitting height during the first one-half hour following rest gave means of 5.4 mm. and 4.4 mm., respectively. In relation to mean loss for the first hour, these figures imply that in the case of stature 66 per cent of the loss occurs between the termination of rest and thirty minutes later, while in the case of sitting height the loss for one-half hour is 57 per cent of that for one hour.

LOSS FOLLOWING REST IN RELATION TO ACTIVITY

An attempt was made to investigate the influence of the type of activity in which a child engages during the first hour after rest upon the amount of loss in stature for the same interval. The cases employed were the same as in the previous section. Prior to reporting the findings, it is pertinent (1) to give a brief description of the preschool program being followed at the time of the study and (2) to define the activity categories employed.

The early part of the post-rest program was standard for all children. Approximately the first fifteen or twenty minute period after rising was occupied by the routines of toileting and lunch. Choice among several activities was then available, varying from day to day. Those in which the cases of the present study were engaged on the days they were observed were classified into three groups according to an estimate of the amount of bodily activity expended. The groups were designated "slight activity," "moderate activity," and "vigorous activity."

Under the category of slight activity were included such occupations as listening to music or stories; painting, pasting, or coloring while seated at a table; and block building with small blocks while seated on the floor. Moderate activities covered such types of motion as walking about, standing, and reaching; painting at an easel; water play at an indoor tank; clay modeling; and block building involving moderate activity. Vigorous activities were those requiring strenuous movements of the whole body: marching; block building with large blocks accompanied by running, pushing, hauling, and carrying; and outdoor play on trapeze, rings and horizontal bar, or running, jumping, and similar activities.

The findings for each of the twenty-two cases employed are shown in the tabulation on the following page.

Case	Gain During Rest	Loss During First Hour	Percentage of Gain Lost
		Slight Activity	
1	11	1	9
2	11	5	45
3	13	6	46
4	12	7	58
5	10	6	60
6	11	7	64
7	9	6	67
8	12	12	100
		Moderate Activity	
9	21	9	43
10	11	7	64
11	14	10	71
12	18	13	72
13	5	4	80
14	10	9	90
15	7	13	186
		Vigorous Activity	
16	14	12	86
17	10	9	90
18	7	7	100
19	8	8	100
20	12	12	100
21	15	15	100
22	8	12	150

Selected findings indicated are:

1. Seven of the eight cases in the slight activity group show a loss during the first hour of less than 70 per cent of the gain during rest. In contrast, all of the cases in the vigorous activity group show a loss of more than 80 per cent of the gain during rest.
2. Five of the eight cases in the slight activity group show loss during the first hour of 60 per cent or less of the gain during rest. Percentages of gain lost fall between 64 and 90 for five of the seven cases in the moderate activity group and above 90 for five of the seven cases in the vigorous activity group.

SUMMARY AND CONCLUSIONS

Changes in the stature and sitting height of four-year-old preschool children are studied in relation to an afternoon rest in the recumbent position and in relation to physical activity during the first hour following the rest period.

For the total cases studied, it is found that during a rest period of approximately one and three-fourth hours duration there occurs a mean increase of 9.3 mm. for stature and 7.7 mm. for sitting height. For cases who rested roughly two hours and who slept more than one-half of this time, a mean gain is obtained of 11.7 mm. for stature and 10.1 mm. for sitting height.

In the case of the subjects who rested two hours and were asleep about one and one-fourth hours, a mean loss in stature and sitting height is found during the first hour after rest. This loss is equivalent to 70 per cent and 67 per cent of the mean gain during rest for stature and sitting height, respectively.

On the whole, the losses obtained in stature during the first hour following rest are greater for cases observed to engage in vigorous physical activities than for those occupied at relatively nonstrenuous tasks.

The findings are considered to warrant two conclusions: first, that the changes in stature and sitting height of four-year-old children associated with an afternoon rest period are appreciable -- the mean gain under conditions of rest with sleep is found to be equal to two months growth for children of this age; and, secondly, that the changes are sufficiently marked to necessitate that repeated measurements of stature and sitting height on the same children at bimonthly or quarterly intervals should be made with direct reference to the rest period, e.g., if a child is given his initial examination before rest he should be examined before rest on successive occasions.

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THE MENTAL DEVELOPMENT OF ADOPTED CHILDREN WHOSE TRUE MOTHERS ARE FEEBLE-MINDED

MARIE SKODAK[1]

Among the numerous questions in the field of mental deficiency, one in particular has practical implications for child welfare. It runs something like this, "Since mentally deficient girls are such notorious sources of illegitimate children, what policy ought to be adopted with reference to these children? Are they doomed to feeble-mindedness and life-long institutional care? Or can they be placed in normal adoptive homes with reasonable expectation that they will develop into normal children?"

The experimental evidence which should form the basis of a reply to this question consists of the placement of young infants of known feeble-minded parentage in normal, average homes where they will grow up as integral members of the family. Such experiments are probably not infrequent in the placement of children for adoption. However, the combination of definite information on the parentage and on the mental development of the child is rare. It happens that this information is available on the progress of a group of such children so placed in Iowa. Since the first results of the larger program, of which this study is a part, have been made available elsewhere (2), only brief references to the general results will be made.

Through the co-operation of the Iowa Child Welfare Research Station, the Iowa State Board of Control, and the Iowa Children's Home Society, a program for the study of the mental development of foster children has been underway for the past four years. At the present time special attention is being focused on the study of the mental development of those children who were placed in adoptive homes under the age of six months. Since the mean age at placement was approximately three months, the children were placed in their permanent homes without having experienced the environmental influences of their true mothers' homes.

Out of a total group of 154 children placed under the age of six months, whose mothers ranged from feeble-minded to superior in intelligence, it was possible to select sixteen children whose mothers were definitely known to be feeble-minded, not only on the basis of intelligence test scores but also on the basis of qualitative diagnoses by the examiners, school and occupational histories, and social adjustment. Recommendation for institutional care or very close social supervision had been made in all these cases.

That this group of sixteen is definitely selected for inferiority of true parents is evident when the group is compared to the total group of 154 foster children, as shown in Table 1.

TABLE 1

	Children of Feeble-Minded Mothers			Total Group of Foster Children		
	Number	Mean	S.D.	Number	Mean	S.D.
Mothers' IQ	16	66.4	6.3	80	87.7	15.8
Mothers' education	15	7.6	1.2	144	9.9	2.2
Fathers' education	7	9.0	1.8	88	10.2	2.5
Fathers' occupational classification	10	6.3	.8	110	5.4	1.8

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The mean IQ of the sixteen mothers is 66.6 with a range from 54 to 74. The mean IQ of eighty mothers of the total group for whom this information is available is 87.7 with a range from 54 to 128. These results are based on the 1916 revision of the Stanford-Binet given by qualified psychologists. The results of the examinations were substantiated by qualitative observations of the behavior and adjustment of the individuals both at time of examination and as judged from the case histories.

The mean education of the mothers of the selected group is 7.6 grades completed with no mother reporting attendance beyond the eleventh grade. The mean education of the mothers of the total group is 9.9 grades and covers the academic range to fourth year in college. The reported education of the mothers is higher than that usually predicted for individuals of this mental level. By no means, however, does it represent the actual achievement in school. The evidence from social histories and school records indicates that the group was markedly over age for grade, and had done consistently inferior school work. The mothers, at least, belong to that group of school problem children who, lacking opportunity for special education or suitable vocational placement and held by compulsory education laws, are tolerantly passed from grade to grade on the basis of age and physical maturity rather than academic progress.

In the absence of intelligence test results for the fathers, their mental level may be inferred from their education and their occupational classification. The fathers of the selected group completed a mean of 9 grades. One father had completed high school and had had one semester beyond that. The fathers of the total group had completed a mean of 10.2 grades and ranged in education through four years of college. Comparison of the occupations of the fathers whose education is known with those whose education is unknown showed no difference between the two groups and it was concluded that the former may be considered representative of the educational level of the entire group.

The occupational classification used in this study is that devised by Goodenough (1) and based on the occupational classification of employed males in the United States. Group I represents the professional occupations, Group II the semiprofessional and managerial, Group III the clerical and skilled trades, Group IV the farmers, Group V semiskilled occupations, Group VI slightly skilled trades or other occupations requiring little training or ability, and Group VII unskilled laborers of all types. According to such a classification the true fathers of the selected group have a mean of 6.3, which falls between the unskilled and very slightly skilled categories. The fathers of the entire group of foster children have a mean occupational classification of 5.4, while the mean for the entire United States, based on the distribution of the 1930 census is 4.8. Only two fathers of the children of feeble-minded mothers were reported in occupations as high as Group V and these were a cobbler and a grocery store clerk. Eighty per cent of the fathers of the selected group were in the lower two occupational classes, as compared to 57.3 per cent for the total group and 30.8 per cent for the population as a whole.

The families of the sixteen children are distinguished for long records in welfare offices even during predepression years and for familiarity with various state and local penal, mental hygiene, and charitable institutions. Judging from these facts and from the general tenor of the material in the case folders, the examination of the children was preceded by apprehension that they would be markedly inferior in intelligence to the level of the foster families.

All the foster parents are highly selected on qualitative bases since references, social standing in the community, and similar factors are carefully scrutinized before a child is placed in the home. However, comparison of the two groups of foster parents in Table 2 shows that there was a slight tendency toward selective placement.

The mean education of the foster parents of the selected group is 10.8

TABLE 2

	Children of Feeble-Minded Mothers			Total Group of Foster Children		
	Number	Mean	S.D.	Number	Mean	S.D.
Mothers' education	16	10.6	2.6	152	12.0	2.7
Fathers' education	16	10.8	3.4	153	12.0	3.8
Fathers' occupational classification	16	3.8	1.8	154	3.1	1.4

grades for the fathers and 10.6 grades for the mothers, while the mean for the foster fathers and mothers of the total group is 12 grades completed. The distribution of the proportions of the foster parents who have completed varying amounts of education, shown in Table 3, confirms the evidence for some selection in the placement of these children, but also emphasizes the fact that the number and the proportion of those foster parents whose education was limited to the elementary grades is very small.

The mean occupational classification of the sixteen foster fathers is 3.8, while the mean for the total group is 3.1. These are both well above the mean of 4.8 for the population as a whole.

Thus there is a group of sixteen children, whose true-family history is extremely poor, who have at least one parent known to be feeble-minded, but who were placed at a very early age in foster homes above the average of the general population from the standpoint of occupation and social status. It is possible to compare the mental development of these children with that of a larger group of adopted children whose true-family history, while inferior to that of the population as a whole, is not as extreme in its deviation. Both groups of children have experienced essentially only the environment of the adoptive homes and the foster homes of the children of known mentally defective mothers do not differ significantly from those of the group as a whole.

All the children were given at least two intelligence tests during the course of this study. The first, given at the time of application for the completion of adoption and following at least one year of residence in the foster home, was given at a mean age of two years, one month for the total group. The second examination, given after an interval of one to three years, was given at a mean age of four years, four months for the total group. Ages at the time of first examination ranged from one to seven years, and at time of last examination from two to ten years for the entire group. At the time of first examination the selected group had a mean chronological age of two years, six months with a range from one to five years, and on second examination a mean age of five years with a range from two to seven. Throughout

TABLE 3

	Foster Parents of Children of Feeble-Minded Mothers		Foster Parents of Total Group of Children	
	Fathers	Mothers	Fathers	Mothers
Beyond high school	25.0	31.3	39.2	39.5
High school (9 to 12)	31.3	37.5	34.0	44.0
8th grade completed	31.3	25.0	24.8	12.5
Less than 8th grade	12.5	6.3	2.0	4.0

TABLE 4

INTELLIGENCE TEST RESULTS OF CHILDREN OF FEEBLE-MINDED MOTHERS COMPARED TO TOTAL GROUP OF CHILDREN PLACED UNDER SIX MONTHS OF AGE

	Children of Feeble-Minded Mothers			Total Group of Foster Children		
	Number	Mean IQ	S. D.	Number	Mean IQ	S. D.
	Children Placed in All Types of Foster Homes					
First examination	16	116.4	11.6	154	116.0	13.6
Last examination	16	107.6	12.9	154	111.5	13.2
	Children Placed in Foster Homes in the Three Upper Occupational Classifications					
First examination	8	118.9	11.0		116.0*	
Last examination	8	111.4	10.7		114.0*	
True mothers' IQ	8	63.9	4.9	46	89.7	16.3
	Children Placed in Foster Homes in the Four Lower Occupational Classifications					
First examination	8	113.9	11.4		113.7*	
Last examination	8	103.9	13.7		104.5*	
True mothers' IQ	8	68.9	4.1	34	86.1	12.6

*Values read from smoothed curved at ages corresponding to mean age at examination of the children whose mothers are feeble-minded.

the study children under three and one-half years were given the 1922 revision of the Kuhlmann and those older were given the 1916 Stanford. The results of the examination are given in Table 4.

The mean IQ on first examination of the group of sixteen children whose mothers were known to be subnormal was 116.4. The mean for the total group of 154 children was the same. The sixteen children ranged from 95 to 131 IQ and the total group from 80 to 162, with only five children or 3 per cent of the total under 90 IQ. No child was classified as borderline or lower in intelligence.

On re-examination after an interval of one to three years, the sixteen children had a mean IQ of 107.6 with a range from 81 to 132. The mean IQ of the total group was 111.5 with a range from 81 to 149.

When the mental development of the children of feeble-minded mothers is compared to that of the total group on the basis of the type of foster home in which the children were placed, it is seen that the selected group follows the same pattern of development as the total group. The eight children of mentally defective mothers, placed in foster homes in the three upper occupational categories, on first examination at a mean age of three years, five months had a mean IQ of 118.9. Re-examined at a mean age of five years, five months, their mean IQ was 111.4. At the same ages the mean IQ's of those children of the total group who were placed in similar homes were 116 and 114. Eight children of mentally defective mothers, who were placed in foster homes in the four lower occupational categories, on first examination at a mean age of one year, eight months had a mean IQ of 113.9. On re-examination at a mean age of four years, three months these children had a mean IQ of 103.9. Children of the total group placed in similar homes and examined at the same mean ages were practically identical in mean IQ. The extent to which the curves of mental development of these two groups of children coincided, compared as total groups and according to the types of foster homes in which they were placed, is graphically shown in Figure 1.

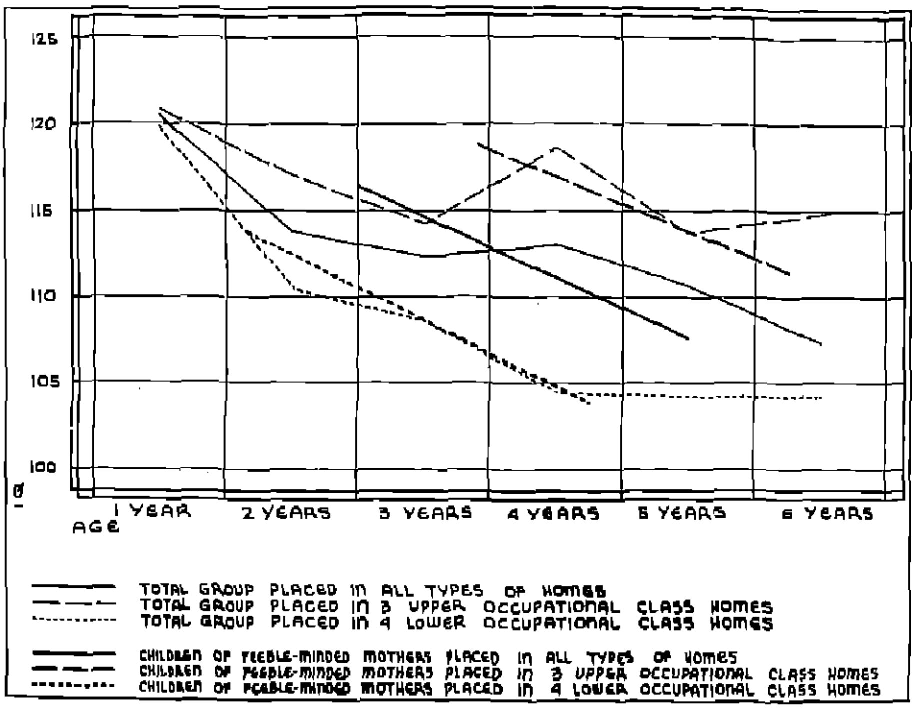

Fig. 1. Comparison Between Mental Development of Children of Feeble-Minded Mothers and Total Group of Foster Children, by Age at Test, Mean IQ and Foster Father Occupational Classification.

The differences between the intelligence levels of the mothers of the selected children as compared to the total group amounting to 26 points for children in the three upper classification homes and 17 points in the four lower classification homes, appear to have no differentiating influence on the mental development of the children. If any difference exists between the family backgrounds of the selected children who were placed in the two types of foster homes, it is in favor of the children in the lower homes. Yet their mean IQ is materially below that of the children in the better foster homes.

SUMMARY OF RESULTS AND CONCLUSIONS

While the number of cases reported here, whose mothers are known to be mentally defective, is not large, the results consistently point in the same direction. They may be summarized briefly as follows:

1. The children of feeble-minded mothers, like the entire group of adopted children placed under the age of six months, are higher in intelligence than would be expected from the true-family histories.
2. None of the children placed under six months of age, regardless of the degree of mental defect of the mother, has been found to be subnormal in intelligence and none has been found to be of borderline mental development.
3. Children of feeble-minded mothers placed in foster homes of the higher occupational levels and children of feeble-minded mothers placed in foster homes of the lower occupational levels show the same mean level of intelligence and the same developmental trends as do all children, regardless of true-family background, placed in similar homes and examined at the same mean ages.
4. There is no evidence at the present time that a sudden decline to the feeble-minded level can be anticipated for these sixteen children.

The general conclusions which may be drawn from these results are that children of feeble-minded mothers and grossly inferior true-family background, when placed in average and superior foster homes at an early age, are indistinguishable in mental development from children whose mothers are not feeble-minded. The results indicate that if a child is physically normal and if placement is made at so early an age that the child experiences essentially only the environment of the foster home, the mental status of the mother ought to be no bar to the placement of the child in a permanent foster home.

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DEVELOPMENTAL CHANGES IN THE DISTRIBUTION OF PARTS OF SPEECH

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Students in the field of language are emphasizing more and more the functional approach. They are increasingly dissatisfied with the traditional classification of words into parts of speech. Since overlapping between adjective and adverb, preposition and conjunction, adverb and pronoun, even noun and verb is so great that accuracy can be secured only by treating each word according to its usage in the individual instance, Aiken (1) would go so far as to discard the old system of classification altogether and substitute six functions of speech, namely verb, subject, complement, modifier, connective, and the absolute construction. Nothing so radical is attempted in the present paper, although both by subdivision and by grouping of categories an effort is made to detect possible age and sex differences in the use of various parts of speech by children.

McCarthy (4) found that nouns make up about 50 per cent of the total speech of very young children; verbs increase in importance from about 14 per cent at 18 months to 25 per cent at 54 months; adjectives increase during the same period from about 10 to about 15 per cent, and pronouns from 10 to about 20 per cent; adverbs show little change with advancing age, interjections decrease, and connectives do not appear at all until the age of two years and thereafter increase steadily in importance. The meagre information available concerning older children (5) indicates that the proportions of parts of speech found at four years remain virtually unchanged.

In a recently completed study of samples from the speech of 436 children between the ages of 5-1/2 and 9-1/2 years (2), the writer made no systematic analysis according to parts of speech, because of this probability that further age changes would not be found. In view of the possibility that a finer subdivision of nouns, verbs, and so on might reveal certain age and sex differences, such a classification has now been made. The findings based on percentage of total words used vary hardly at all from the percentages given by McCarthy for her three highest age levels, 3-1/2, 4, and 4-1/2 years. This fact is especially significant because McCarthy had only twenty subjects at each age, whereas the writer's subjects were concentrated in large groups at three rather widely separated age levels. Table 1 compares the percentages for these older children with McCarthy's 4-1/2-year group and with the mean percentage for her three oldest age groups. The mean was computed because at these ages no consistent developmental trend can be detected. The minor variations are probably chance fluctuations due to the selection of a small number of cases at each age.

In the present analysis adjectives and adverbs were grouped under the heading of "modifiers" for two reasons. First, although children often use an adjective erroneously in place of an adverb, ("I'm awful glad you came") this distinction was not made clear on the summary sheets; second, it is possible that the use of modifiers increases with age. No such increase was found, however, and in computing the totals adjectives and adverbs not used as modifiers were simply added to the list so as to avoid making another tabulation. The total percentage of adjectives and adverbs for McCarthy's subjects of the ages considered was identical with that for the writer's 5-1/2-year-old group, but slightly higher than that for the children aged 6-1/2 and 9-1/2 years respectively. Nouns and pronouns were very slightly less important for older children than for McCarthy's subjects, while the percentage of verbs in-

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[1] From the Institute of Child Welfare, University of Minnesota.

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TABLE 1

MEAN PERCENTAGE OF EACH PART OF SPEECH USED BY CHILDREN OF VARIOUS AGES (BASED ON TOTAL NUMBER OF WORDS)

Type of Word	McCarthy		Zyve (5)	Davis		
	3½, 4, 4½ years Mean of 60 cases	4½ years 20 cases	Third grade	5½ years 248 cases	6½ years 63 cases	9½ years 125 cases
Nouns	19.3	19.3	15	18.5	18.4	17.5
Verbs	25.7	25.1	27	26.2	26.7	27.0
Adjectives	15.2	15.2		22.0	20.0	20.1
Adverbs	6.9	7.0				
Pronouns	20.8	20.5	17.2	19.1	19.6	17.4
Conjunctions	3.2	3.8		2.4	3.4	5.3
Prepositions	7.0	7.1		8.6	8.9	10.1
Interjections	1.3	1.2		2.0	1.4	1.3
Miscellaneous	0.8	0.8		1.4	1.7	1.3

TABLE 2

MEAN PERCENTAGE OF EACH PART OF SPEECH USED BY CHILDREN, ACCORDING TO AGE AND SEX (BASED ON NUMBER OF DIFFERENT WORDS USED)

Type of word	McCarthy		Davis					
	4½ years		5½ years		6½ years		9½ years	
	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls
Nouns	36.0	36.8	43.1	45.9	41.4	44.4	41.4	42.5
Verbs	27.8	25.5	26.9	26.0	29.9	27.7	30.3	29.8
Adjectives, adverbs	21.2	21.0	18.3	17.9	17.1	16.7	19.4	19.1
Pronouns	6.5	7.1	2.7	2.5	3.6	3.5	2.6	2.6
Conjunctions	1.2	2.4	1.3	1.3	1.7	1.7	1.3	1.4
Prepositions	3.6	3.8	2.6	2.6	3.3	3.1	2.9	2.8
Interjections	2.0	1.4	4.2	3.0	2.0	2.1	1.4	1.0
Miscellaneous	1.7	2.1	0.8	0.8	0.9	0.8	0.7	0.8

creased only from 25.7 for the young children to 27.0 at 9-1/2 years. Prepositions and conjunctions, which appear last in children's speech, increased very slightly with advancing age.

Percentages computed on the basis of different words used show somewhat greater age changes, although the findings for all groups combined are very close to those of Zyve (5) for her third-grade subjects. Table 2 compares the groups by age and sex with McCarthy's 4-1/2-year group. By the age of four years children seem to have acquired all the commonly used pronouns, prepositions, and conjunctions, so that as their vocabulary grows there can be no proportionate increase in these categories of speech. They ring the changes on a common stock of adjectives, adverbs, and irregular verbs, while the gradual mastery of a wealth of name words and regularly inflected verbs accounts for vocabulary growth.

One would suspect, therefore, that the separation of nouns and verbs into finer subdivisions would bring out some significant trends. Nouns were classified as names for human beings, names of specific persons and places (3), names of animals, names of objects, and abstract or collective nouns not included in the previous categories. Table 3 and Figure 1 give the percentage distribution of the nouns among the several categories on the basis both of total and of different words used. There is a striking similarity in pattern for both sexes and for all age groups. Children at 9-1/2 years used a higher percentage of words naming human beings than children at 5-1/2 or 6-1/2 years. Apart from proper names, 135 different nouns were used by the 436 children to refer to human beings. Such words ranged from "Indian" with 1,656 occurrences, to "millionaire," "beggar," "bandit," "herdsman," and "flag-bearer," each recorded once. They made up 3.9 per cent of the total speech of children at

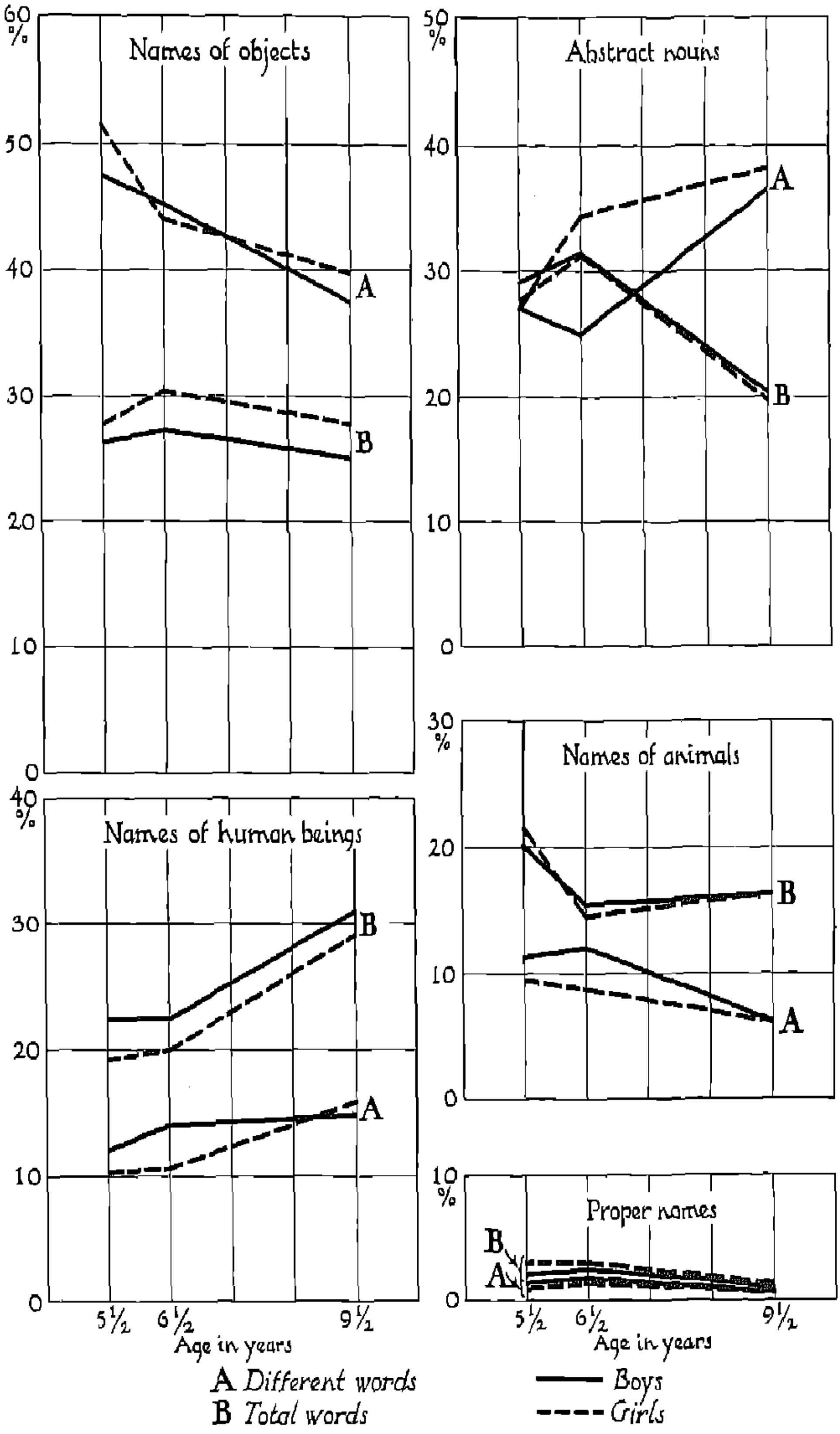

Fig. 1. Percentage distribution of different types of nouns among the several categories, for boys and for girls at various ages.

TABLE 3

PERCENTAGE DISTRIBUTION OF DIFFERENT TYPES OF NAME WORDS
USED BY CHILDREN, ACCORDING TO AGE AND SEX

Age	Sex	Percentage of Total Nouns					Percentage of Different Nouns				
		Human Beings	*Proper* Names	*Ani-* mals	*Ob-* jects	*Abstract* Terms	*Human* Beings	*Proper* Names	*Ani-* mals	*Ob-* jects	*Abstract* Terms
5½...	Boys	22.5	2.2	20.1	26.1	29.2	12.1	1.8	11.4	47.6	27.1
5½...	Girls	19.5	3.2	21.6	27.9	27.7	10.5	1.7	9.4	51.7	26.6
6½...	Boys	22.4	2.5	15.7	27.3	31.9	14.6	1.9	12.3	45.6	25.5
6½...	Girls	20.3	3.1	14.4	30.5	31.6	10.9	1.8	8.9	44.3	34.1
9½...	Boys	31.5	1.7	16.2	25.2	25.4	15.0	1.4	6.7	37.8	39.0
9½...	Girls	29.4	1.4	16.3	28.0	24.9	16.3	1.4	6.0	39.8	36.5

5-1/2 years and 5.3 per cent of that of children at 9-1/2 years. At each age the percentage was slightly higher for boys than for girls.

The younger children, on the other hand, used a slightly higher percentage of names of animals. Many of the 5-1/2-year-old children were so retarded in speech that they were still at the "naming" stage of development, and such a response would naturally follow the presentation of the array of little animals used in the standardized situation set up for the purpose of obtaining the language records (2). The percentage of names of objects is relatively constant for total speech, but decreases with age when the number of different words used is the basis of computation. Girls used rather more names of objects than boys. The percentage of abstract and collective terms in total speech was actually a little lower at 9-1/2 than at 5-1/2 years, but it becomes appreciably higher when the percentage is based on the number of different terms of this kind. In other words, although the young children frequently used such nouns as "kind," "light," "matter," "plenty," and "end," the older ones used them in much greater variety, and added "danger," "direction," "pleasure," "protection," "ambush," and "dawn."

Grammarians and educators have pointed out again and again that the total frequency of the common irregular verbs is astoundingly high. Verbs used by the children in this study were classified as regular and irregular, and the irregular verbs sometimes used as auxiliaries were separated according to the percentage of such use. Regularly formed verbs accounted for only 15 per cent of the total verbs used at 5-1/2 years, and for only 19.5 per cent of those used at 9-1/2 years. Of the 80 to 85 per cent of all verb forms that are irregularly inflected, from 25 to 30 per cent are distributed among the 48 forms (including contractions with "not") used as auxiliary or helping verbs. Less than half the total usage of these 48 forms, however, is auxiliary in function. In other words, the child "has" something more often than he "has" to go somewhere or "has" made something; he is more likely to "go" somewhere than to be "going" to tell a story; and he classifies an object ("This is a horse; he is black") more often than he states that the horse "is" running. Table 4 shows that this distribution varies in turn with the different verbs. "Got" is auxiliary in only about 3 per cent of its occurrences, "can" in from 85 to 90 per cent, and "shall" and "will" in 100 per cent.

Table 4 shows that variations with age in the use of the auxiliary verbs are of little importance. There is an increased use of "be," "have," "shall," and "will" as auxiliaries by older children, undoubtedly to form participial phrases and perfect and future tenses. It is in the number of regular verbs used that development is found. There were in all 323 different regular verbs, and 140 irregular verb forms in addition to the auxiliary forms already discussed. (Each irregular form was listed separately--"see," "saw," "come,"

TABLE 4

USE OF THE MOST COMMON AUXILIARY VERBS BY CHILDREN
AT THREE AGE LEVELS

Verb	Percentage of its Total Use Which is Auxiliary			Percentage of Total Auxiliary Verbs			Percentage of All Irregular Verbs		
	5½	6½	9½	5½	6½	9½	5½	6½	9½
be	28.0	29.5	42.9	37.0	33.8	40.5	33.7	36.8	29.5
do	65.3	62.3	67.6	18.8	17.7	8.7	7.3	7.6	3.9
have.....	21.1	19.4	24.4	4.9	6.1	6.1	6.0	8.6	7.7
can	85.3	86.1	90.4	13.0	10.4	12.8	3.8	3.2	4.4
go	37.3	38.0	34.2	11.6	10.1	9.6	8.0	7.0	8.7
got	2.6	3.1	5.1	0.6	0.6	0.4	5.2	5.1	2.4
will	100.0	100.0	100.0	11.8	17.1	16.6	3.0	4.5	5.5
shall ...	100.0	100.0	100.0	1.3	1.6	2.2	0.3	0.4	0.7

TABLE 5

PERCENTAGE DISTRIBUTION OF REGULAR AND IRREGULAR VERBS
USED BY CHILDREN

Age	Sex	Type of Verb		
		Regular	Auxiliary	Other Irregular
		Total Verbs		
5½	Boys	14.8	21.2	64.0
5½	Girls	15.3	22.0	62.7
6½	Boys	20.6	21.1	58.3
6½	Girls	14.2	22.9	62.9
9½	Boys	20.1	23.8	56.1
9½	Girls	19.2	27.1	53.7
		Different Verbs		
5½	Boys	52.3	14.9	32.4
5½	Girls	51.7	15.0	33.3
6½	Boys	46.6	20.2	33.2
6½	Girls	45.4	20.3	34.3
9½	Boys	54.9	13.7	31.3
9½	Girls	53.4	13.1	33.4

"came.") The distribution of verbs according to number of different ones used as shown in Table 5 gives an idea of the great variety of regularly formed verbs employed.

Table 6 summarizes the actual occurrence in total speech of the most common everyday words. At each age the occurrence of forms of the verb "to be" approximately equalled that of the verbs "go," "do," "have," "got," "can," and "will" combined. The total occurrence of these common irregular verbs was about one-half that of the most common pronouns and modifiers and approximately 40 per cent of all the other common words listed. More than 50 per cent of the total speech of these children was composed of the words in this table. That is, all the remaining irregular verbs, all regular verbs, all other pronouns, modifiers, and connectives, all nouns, and all interjections barely equal in total frequency the occurrence of the words listed in Table 6. Such is language!

Another partially successful attempt at isolating age and sex differences was made by grouping certain words according to their central meaning, irrespective of grammatical usage. Thus, the writer suspected that the brighter children had a tendency to use expressions referring to the higher mental processes, such as "think," "wonder," "suppose," "know." The critical ratio between total number of "thinking" words per child at 5-1/2 years and at 9-1/2

TABLE 6

PERCENTAGE DISTRIBUTION OF MOST COMMON WORDS IN TOTAL SPEECH OF CHILDREN

Type of Word	Word	Age in Years		
		5½	6½	9½
Forms of common irregular verbs	be	7.5	8.1	6.4
	go	1.8	1.5	1.8
	do	1.6	1.7	0.8
	have	1.3	1.9	1.6
	got	1.1	1.1	0.5
	can	0.8	0.7	0.9
	will	0.7	1.0	1.2
Total verb forms		14.8	16.0	13.2
Forms of personal pronouns	first person	3.4	4.1	2.2
	third person	6.5	7.0	9.2
Modifiers				
Articles	a, an, the	6.3	6.4	7.3
Demonstratives	this, that, these those, here, there	8.1	9.6	9.1
Numerals	one	1.9	2.1	1.2
Total Pronouns and modifiers		26.2	29.2	29.0
Connectives				
Conjunctions	and	1.5	2.0	3.5
Prepositions	to	1.9	2.0	2.9
	of	1.1	1.2	1.1
	in	0.8	1.1	1.2
	up	1.2	1.1	0.6
	on	0.8	0.6	0.8
Total connectives		7.3	8.0	10.1
All words in this list		48.3	53.2	52.3

TABLE 7

CORRELATION BETWEEN NUMBER OF "THINKING" AND "SENSORY" WORDS AND IQ

Age in Years	"Thinking" Words	"Sensory" Words
5½	.21 ± .04	.18 ± .04
6½	.25 ± .07	.05 ± .08
9½	.27 ± .06	.07 ± .06

years was 3.21. At each age there was a slight positive correlation (Pearson product-moment method) between the number of such expressions and intelligence. A relationship of about the same magnitude had been found between total words used and intelligence. Although only a little more than one per cent of the total words used at each age were "thinking" words, there was a very slight increase with advancing age. This change is more noticeable when the percentage is calculated on the basis of different words used. Boys used a greater variety of such words than girls.

A similar list of words, the central theme of which is the primary sensory functions of sight and hearing, showed little relationship with development, although there was a suggestion that the percentage might be higher in girls than in boys. The correlations with intelligence (Table 7) were approximately zero except at 5-1/2 years.

Finally, all words referring to large-muscle movements (action words) were

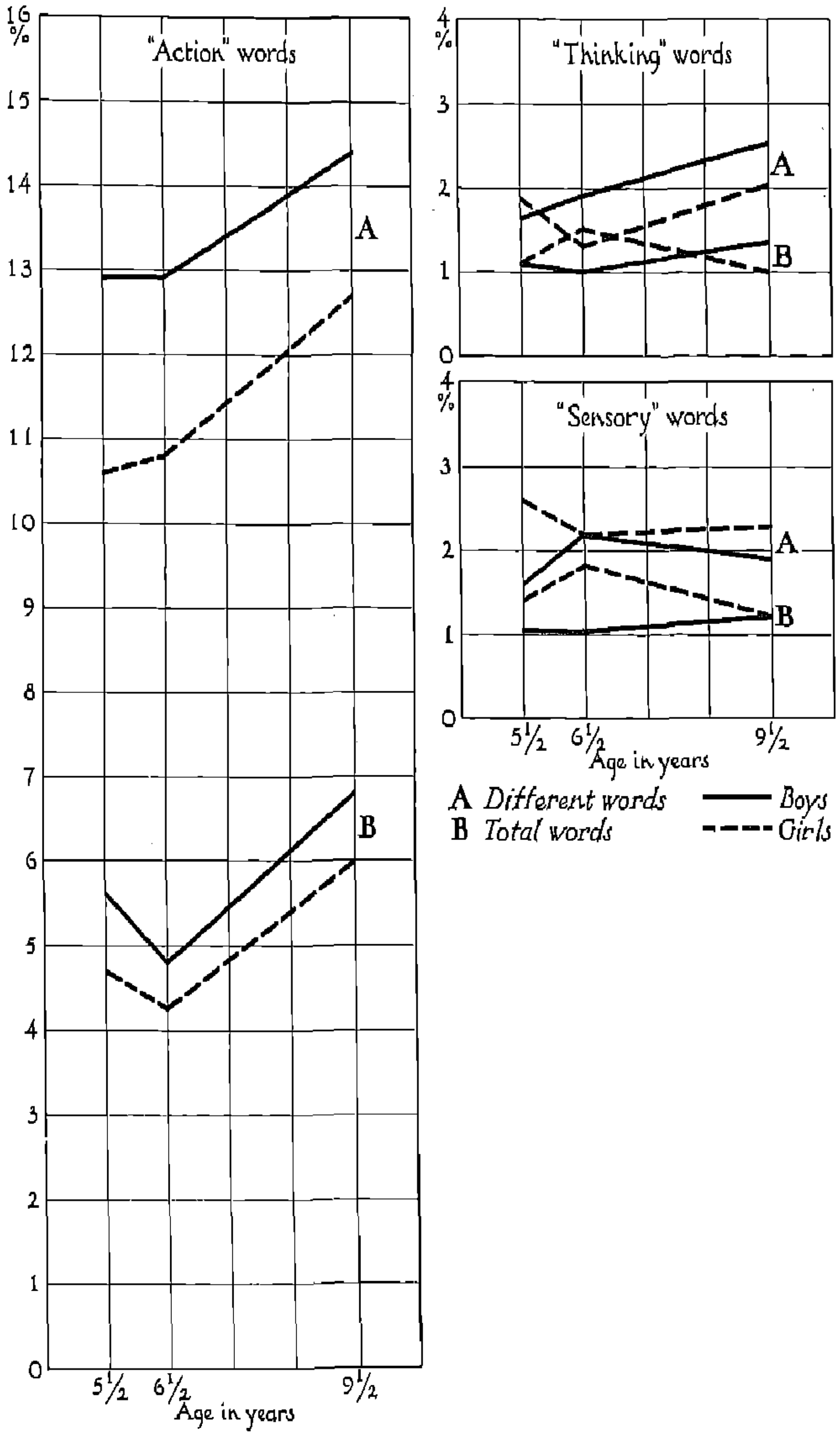

Fig. 2. Percentage distribution of "action," "thinking," and "sensory" words for boys and for girls at various ages.

TABLE 8

PERCENTAGE DISTRIBUTION OF "THINKING," "SENSORY," AND "ACTION" WORDS USED BY CHILDREN

Age in Years	Percentage in Total Speech Boys	 Girls	Percentage of Different Words Boys	 Girls
		"Thinking" Words		
5½	1.06	1.10	1.63	1.86
6½	1.00	1.54	1.87	1.34
9½	1.37	1.00	2.51	2.05
		"Sensory" Words		
5½	1.07	1.38	1.63	2.65
6½	1.07	1.82	2.16	2.14
9½	1.26	1.22	1.93	2.25
		"Action" Words		
5½	5.62	4.74	12.94	10.62
6½	4.79	4.26	12.95	10.83
9½	6.82	6.04	14.41	12.71

listed. The percentage of such words shows a clear-cut sex difference in favor of boys and a definite increase with advancing age. Table 8 and Figure 2 show the findings for "thinking," "sensory," and "action" words.

SUMMARY

1. The percentage distribution of the various parts of speech in children's language, based on total words used, is practically unchanged between the ages of 3-1/2 and 9-1/2 years.

2. Percentages based on number of different words used show a slight increase with age in number of nouns and regular verbs, but a decrease in pronouns, conjunctions, and prepositions.

3. With advancing age, children use a higher percentage of nouns naming human beings, but a slightly lower percentage of nouns naming animals. The percentage of nouns naming objects and abstract and collective terms does not change with age when the percentage is based on total words. When it is based on different words, there is a decrease in names of objects but an increase in abstract and collective nouns.

4. Age differences in the use of the different auxiliary and other irregular verbs are very slight.

5. Since age and sex variations in the percentage distribution of parts of speech are not of sufficient magnitude to change the pattern described by previous investigators, a more promising field for future research will be found in word meaning and function than in the traditional classification by parts of speech.

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A STUDY OF THE DEVELOPMENT OF THE ABILITY TO CARRY A MELODY AT THE PRESCHOOL LEVEL

ETHEL NATALIE DREXLER[1]

INTRODUCTION

The ability to carry a melody involves a coordination among many sensory and intellectual factors. To carry a melody accurately, the child must link the tones he hears with the tones he reproduces. In addition to possessing sensitivity to the kinesthetic action in his throat and diaphragm and the perception of the tones heard, he must remember the tunes and the individual phrases when attempting to reproduce them vocally. Hence, it is clear that the ability to carry a melody is very complex and far different from the immediate reproductions of tones or intervals. Previous studies in the preschool field have been largely confined to the analysis of the separate functions involved in singing, rather than to the use of these separate functions in singing a melody. Because the child is learning to carry a melody, one must be careful, in judging his performances in singing, to distinguish between quality based on aesthetic standards, and ability to follow a given melodic sequence. The latter process is of primary interest in the present study. After the child has mastered the rudiments, one may look for finer differentiations between the gifted musician and the one who sings merely for the amusement of himself and his intimates.

REVIEW OF THE LITERATURE

The past experimental literature on the singing ability of preschool children may be divided into three groups:

1. Intervals sung most easily. The first study was made by Werner (9) (cited by Stern), who analyzed the spontaneous song creations of children between two and five years. He claimed that the fundamental form of the childish tune is the minor third in descending order. The descending order is the earliest, since "the main energy of the melodic discharge is displayed to begin with, and a deeper tone is automatically produced with the diminished power of expiration."

Vance and Grandprey (11) in 1931 also concluded that the descending intervals are sung more accurately and more often by preschool children. In the same year, Jersild and Bienstock (5), from an extensive study of tonal intervals, concluded that the narrower intervals, namely seconds and thirds, are sung most easily and most frequently in descending order by preschool children. Especially interesting was the demonstration that children with specific training improved their initial performance in singing intervals, and that the children not so trained remained at their original status. In a follow-up study published in 1934 (6), the same authors found that after a lapse of two years the children who had received training retained their superiority over the control group. Other subjects used in the 1934 study substantiated the earlier findings, namely that narrower intervals were sung more readily than wider intervals, but that after a period of training these differences tended to disappear. Williams (12) in his study of 1933 also concluded that wider intervals are more difficult for the preschool child to sing than are narrower intervals.

The intervals used in the present investigation were almost exclusively seconds and thirds. An attempt was made to compose the songs so that the differences in singing ascending and descending intervals might be clearly observed.

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CHILD DEVELOPMENT, Vol. 9, No. 3 (September, 1938)

2. Pitch level and pitch range. The earliest study in this connection was done by Gutzmann (1) in 1909. He found that 75 per cent of his subjects, who ranged in age from birth to 6 years, sang notes ranging from F to A at the age of one to two years, from E to A at the age of three to five years, and from D to A at the age of six years.

No further study was made on this topic until 1931, when Jersild and Bienstock (5) published the findings of their research. They found that notes from middle C to A were sung most readily by their subjects. These findings clearly indicate that children's voices are placed lower than was commonly supposed. After a period of training this initial range was extended to include notes from middle C to F above C an octave higher. The authors conclude that children achieve the ability to sing a wider range of tones at a comparatively early age if they are so trained.

In 1933, Hattwick (2) made a survey of pitch range and pitch level in the singing of preschool children. He concluded that the mean pitch level used by children in singing voluntarily is significantly lower than the pitch levels for these same songs as printed in the song books. Hattwick further indicated that the mean pitch range of preschool children is 10.5 semi-tones extending from E to E#. Williams (12) in a study also published in 1933, states that the mean pitch range of the subjects that he used falls within the octave from middle C to C above.

In the experiment done by Jersild and Bienstock in 1934 (6), a more extensive sampling was used than in the previous studies. It was found that there is a definite increase in the number of notes sung by the children at the ages from 2 to 5 years, namely from five notes at two years of age to ten notes at five years.

The songs composed for this study attempted to place the range within the normal capacity of children at the preschool level, as indicated by the previous investigators. The two songs included a range of not more than one octave, beginning on middle C and extending to the C above.

3. Studies made on the ability to reproduce phrases. The experiments now to be cited are the most pertinent to the present study. The earliest investigation was carried out by Monroe (0) in 1903. His subjects were taught to sing the scale and a simple song. After a fortnight, the children were tested on their retention of both. It was found that in all cases the song was remembered better, and that there was a steady increase from the age of two to five years in this ability. Monroe offers as an explanation the fact that the children are particularly interested in the movement of a song and in the rhythm, and that they are influenced by associations made between the songs and concrete realities.

In 1933 Hissem (3) published the findings from a study of children from 21 to 59 months of age. It was found that only two of the subjects could successfully combine tones, and hence Hissem concluded that the nursery school songs usually taught to children are too difficult for actual reproduction. The present writer feels that these conclusions are too pessimistic. From the results to be cited now, it may be seen that not only are there a great number of children who can learn to sing a melody accurately, but also that this initial group may be extended by training.

Williams (12) in 1933 found that the immediate reproduction of three-note phrases was as easy to sing as the reproduction of single notes. He found that there was a definite increase in the ability to reproduce phrases with increase in age. In a later study by the same author (13) these earlier findings were substantiated.

We come finally to a discussion of the most recent study of preschool children's ability to sing, one done by Updegraff, Heiliger, and Learned (10). The subjects for this investigation were 66 children ranging in age from 3 to 6 years.

The subjects were arranged in matched groups at each age level. One of the groups was subjected to an intensive training program. After a period of 30 days it was found on the test of reproducing phrases that the three-and four-year-old experimental group doubled their initial scores and that the control group showed no marked improvement in performance. The authors conclude from their findings that the phrase test was the most discriminative test used in their investigation.

The present study, anticipating the increased ability at the older ages to reproduce the melodies, has been primarily concerned with devising an objective method of evaluating the performances of preschool children to carry a melody. In all of the previous studies, analyses were based on subjective evaluations of the experimenters. Since it was found that the most discriminating test of singing ability at the preschool level is the phrase test, an extension of this test was devised by the present writer for this study.

PURPOSES OF THE INVESTIGATION

1. To devise an objective method whereby the ability of the preschool child to carry a melody can be determined from analysis of records made on the Ediphone after a period of training.
2. To discover any age differences among preschool children in the ability to carry a melody, based on this method of evaluation.
3. To find the relationship between the children's home musical backgrounds as well as the abilities of the parents to sing, and the ability of the children to carry a melody.

PROCEDURE

Subjects:

1. Age.--The subjects used in this study were 14 Nursery School and 9 Kindergarten children, three to six years old, who were enrolled in the Nursery School and Kindergarten of the Institute of Child Welfare of the University of Minnesota. The median age was four years and five months. There were seven children between the ages of three and four years, seven children between the ages of four and five years, and nine children between the ages of five and six years. The median age in the three- to four-year-old group was three years and five months; in the four- to five-year-old group, four years and six months, and in the five- to six-year-old group, the median age was five years and three months.

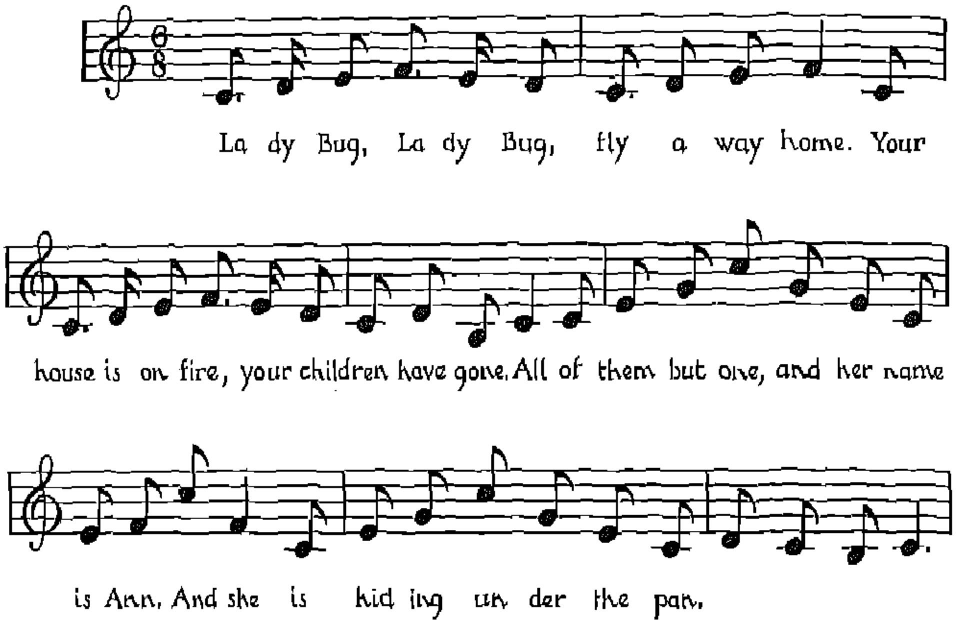
2. Intelligence.--The intelligence quotients of the subjects, as measured by the New Stanford Binet tests, ranged from 105 to 156, the mean being 123. The IQ's were obtained from tests given to the children within one year of the experiment, by trained mental testers of the University of Minnesota.

3. Socio-economic level.--As measured by the Minnesota Occupational Scale, fifteen of the subjects came from the Professional Group, or Group I; six subjects came from the Managerial Group, or Group II, and two subjects came from the Skilled Tradesmen Group, or Group III. The group may be considered as a homogeneous one from the upper socio-economic level.

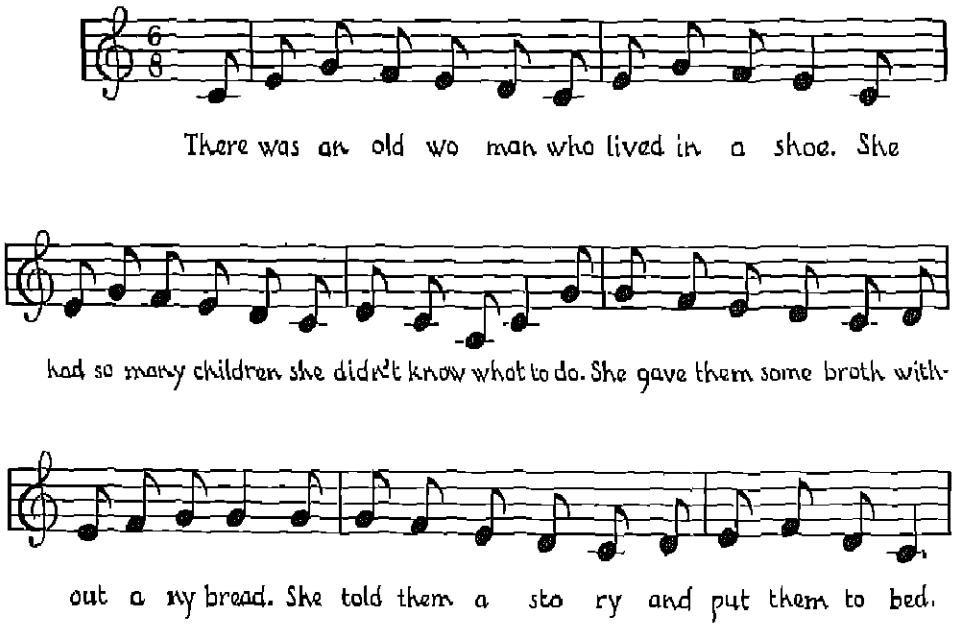
Method:

1. Songs used.--In order to control the factor of unequal exposure to melodies, the experimenter chose two nursery rhymes which were familiar to all of the subjects, but which had never been presented to them in the form of songs. Both of the rhymes were of equal length, and of the same meter. For

LADY BUG


6/8
La dy Bug, La dy Bug, fly a way home. Your
house is on fire, your children have gone. All of them but one, and her name
is Ann. And she is hid ing un der the pan.

OLD WOMAN IN THE SHOE


6/8
There was an old wo man who lived in a shoe. She
had so many children she didn't know what to do. She gave them some broth with-
out a ny bread. She told them a sto ry and put them to bed.

each of these rhymes the experimenter wrote simple melodies. Each of the songs was composed in the key of C major, using 6/8 time, and consisting of eight measures. An attempt was made to keep the two songs as nearly alike as possible in structure and difficulty. Ascending and descending intervals of seconds and thirds predominated, but intervals of fourths and fifths were occasionally introduced.

2. Training period.--The children in each of the schools were assembled in two separate groups for fifteen-minute periods on three alternate days, during which time the words of the songs were taught to them without musical accompaniment. The following week and for four successive weeks the children were taught the melodies to the rhymes, again during fifteen-minute periods on alternate days. Piano accompaniment was used in teaching the song "Lady Bug," and no instrumental accompaniment was used in teaching the song "Old Woman." Each of the training periods was led by the experimenter.

3. Surroundings.--In each case, the training period was held in the regular music rooms of both schools, during the regular music period, and conducted in the same manner as the regular music periods. The children were all well acquainted with the experimenter. The regular teachers were present during the training periods. The room in which the testing was done was familiar to the children. These factors were carefully controlled so as to insure adequate rapport and feelings of ease in the children.

4. Subjects chosen for the experimental group.--Of the original group of fourteen Kindergarten and twenty-six Nursery School children, those selected for the final experimental groups were the fourteen children in the Nursery School who had attended at least nine out of the possible fifteen training periods, and the nine children of the Kindergarten who had attended at least eight of the fifteen training periods. Further training was discontinued, since it was felt by the teachers and the experimenter that after the fifteenth training period each of the children who qualified for the experimental group had reached his optimum performance on the songs. These estimations were based on careful past observations of the children's abilities to sing other songs taught to them during the course of the regular music periods.

5. Testing periods.--The following week the experimenter demonstrated to each child how the Ediphone operated by first singing into the machine herself and then allowing the children to hear the record. In each case the child wished to sing into the machine himself, and was allowed to do so. On this initial trial the child was allowed to sing the songs in the order that he wished. In almost every case, and on the subsequent two trials, "Lady Bug" was the song chosen to be sung first. Although it will be seen that this song was the more difficult of the two, its popularity was probably based on the fact that it was the song taught to the children with piano accompaniment, as well as the fact that it contained a greater variability in tonal pattern.

On the following two alternate days, each child was again asked to sing into the Ediphone. Thus, each of the twenty-three subjects made in all three recordings of both songs. It must be mentioned here that in addition to allowing the children to sing either song first, they were also permitted to start the songs on any note that they chose, being checked by the experimenter only in cases where the notes were obviously too high or too low. In no case was the child prompted by the experimenter in singing; the only help that was given was for the experimenter to speak the words when the child hesitated. Hence, all recordings were made by the children unaided by either instrumental or vocal accompaniment.

6. Records.--After all of the records had been made, the experimenter transcribed the second trial of each song on to specially devised graphs. The model of these graphs will be found later in this report. The third trial of each subject was then transcribed by the experimenter twice, after a period of

one week had elapsed between the first and second transcriptions of these third trials. These transcriptions were not compared during the process.

In addition to the experimenter's transcriptions, three other persons were asked to transcribe the records. In these cases only the third trial was used, since it was found that there was little discrepancy between the two trials (coefficient of correlation between the second and third trials for "Lady Bug" and "Old Woman" were .86 and .89 respectively). One of these individuals had "absolute pitch" and the other two had "relative pitch." Each of the transcribers worked independently. In all, then, 276 transcriptions were made, 138 by the experimenter, and 46 by each of the three others.

In addition to the quantitative analysis made of these 276 transcriptions, that is by counting the number of notes which deviated from the original pattern, each of the transcriptions were ranked from a qualitative point of view, based on the inspection of the graphs by the experimenter.

7. Questionnaires.--Questionnaires containing questions that were weighted and carefully analyzed were sent to the parents and teachers of the subjects. These questionnaires aimed to obtain the teachers' and parents' estimations of the children's abilities to carry melodies and information concerning the home musical backgrounds of the children.

8. Ediphone.--The Ediphone used in this investigation was fitted with a special diaphragm, designed to sensitize the records to voices of young children. The Ediphone used as a means of recording the singing of preschool children had been found to be quite adequate by both Hattwick and Williams. Hattwick (2) says of this recording instrument: "It is an excellent motivating device to use with young children. It is economical both of time and expense. It is simple to operate. It will reliably record pitch changes in singing if properly monitored." A further advantage of this device, as found in the present study, is that the records may be played over many times, enabling the transcribers to check their results. The records may be kept for a considerable length of time without losing their original impressions.

9. Graphs.--The graphic method of transcribing the songs serves as an excellent means of analyzing the reproductions both from the quantitative and qualitative points of view. By plotting the notes sung by the children on to the original patterns, it may be seen how closely the child approximates the original pattern of the song. Furthermore one can analyze the songs from the standpoint of the number of notes sung incorrectly, the number of intervals of all magnitudes sung, the course of these intervals, the reduction of intervals to smaller magnitudes, etc. In the graphs, the solid line represents the original pattern, and the dotted line superimposed on the solid line, represents the pattern of the song sung by the children. The squares running from top to bottom represent the notes in the scale, that is from below middle C to an octave above, in the songs used. The squares running from left to right represent the tonal progressions.

Validity of the Method

The two outside criteria that were used to demonstrate the validity of the method were the parents' and the teachers' estimations of the children's abilities to carry melodies. The coefficient of correlation between the parents' estimations and the evaluation by the experimenter of the children's abilities to carry melodies was .718 ± .018. These coefficients were obtained from the Spearman rank order method, then corrected to Pearsonian coefficients. That between the teachers' rankings and those obtained by the objective method was .707 ± .08. That between the parents' and the teachers' rankings was .64 ± .08. It is felt by the writer that these coefficients may have been spuriously affected by the fact that the possible range obtained from the questionnaires extended from 0 to 3, as compared with the range from 0 to 153 obtained from the graphic method of evaluation. The latter method allows for finer differentiation of abilities. Another factor that may have affected the coefficients obtained is that the parents had no means of comparing their standards of what constituted accuracy of singing with the standards held by the other parents. Hence it is concluded that the coefficients of correlations may be considered to be of sufficiently high order to warrant the assumption that the method is a valid one.

A further device was used to establish a measure of validity of the method, namely by finding the coefficients of correlation existing between the qualitative and the quantitative analyses of the transcriptions. The coefficient of correlation between these two analyses was .95 ± .013 for the second trials and .983 ± .012 for the third trials.

Reliability of the Method

The coefficient of correlation obtained between the second and third trials was .08 ± .03 for the song "Old Woman" and .06 ± .07 for the song "Lady Bug." The intercorrelations among the four independent transcribers were as follows:

TABLE 1

INTERCORRELATION ON SONG "LADY BUG"

Transcribers	1	2	3	4
1		.954 ± .01	.945 ± .016	.908 ± .023
2			.926 ± .022	.852 ± .04
3				.765 ± .058

TABLE 2

INTERCORRELATIONS ON SONG "OLD WOMAN"

Transcribers	1	2	3	4
1		.954 ± .01	.945 ± .016	.954 ± .01
2			.87 ± .036	.964 ± .01
3				.861 ± .03

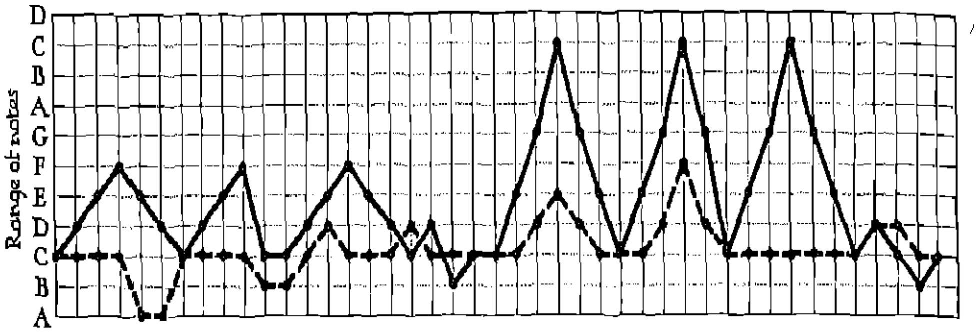
The coefficient of correlation obtained between the songs "Lady Bug" and "Old Woman" on the third trial was .90 ± .02. The fact that in all tests of reliability the coefficients are of such high orders leads the writer to conclude that the method devised is a reliable one, yielding consistent results, and one which may be used by other investigators.

RESULTS

Since it was found that there was a close agreement between the second and third trials, the third trial alone will be used for all further analysis. The writer checked the two transcriptions she had made of the third trials, and found that the coefficient of correlation between them was .981 ± .003.

Graphs for one subject are presented to demonstrate the technique used in transcribing the Ediphone records. This particular graph shows the performance of one of the poorest singers. There were six subjects who sang the songs so accurately that the dotted lines indicating the children's performance coincided exactly with the solid line which indicates the original pattern.

LADY BUG



OLD WOMAN IN THE SHOE

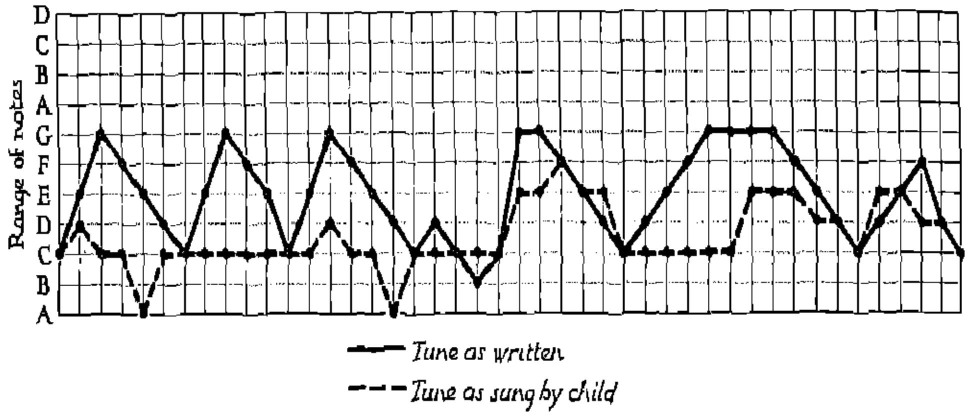


TABLE 3

NUMBER OF NOTES SUNG INCORRECTLY

Ages	Average +*	S.D.	Average -	S.D.	Both	S.D.
			Lady Bug			
3-4	9	4.24	41	17.8	50	22.74
4-5	12	14.66	23	23.19	35	31.79
5-6	2	5.66	11	16.16	15	20.64
			Old Woman			
3-4	21	25.05	20	20.95	41	22.87
4-5	6	6.78	22	23.32	28	24.12
5-6	2	3.16	8	14.31	10	17.15

Critical Ratios

	Lady Bug	Old Woman	Both
3-4 and 4-5	1.00	1.03	1.00
4-5 and 5-6	2.36	1.68	1.22
3-4 and 4-6	4.29	2.99	2.95

* + = Number of notes sung incorrectly above the original notes and the distance away from the correct notes that the substituted note was.

- = Number and distance below the original note that the substituted note was.

1. Accuracy in following the melodies.--Table 3 shows the analysis of the number of notes sung incorrectly by the subjects at the various age levels. As may be seen from the critical ratios, the differences that are most statistically significant are between the ages of three to four, and five to six years. The song "Lady Bug" was found to be more difficult for the children to sing, but the differences are slight. From an inspection of the averages at the age levels, it may be seen that the average number of incorrect notes decreases steadily as age increases. The standard deviations do not follow this trend to any marked degree.

TABLE 4

HOLDING SAME NOTE*

Ages	Lady Bug Average Number Correct	Lady Bug Average Number Introduced	Lady Bug Total Possible Number Correct	Old Woman Average Number Correct	Old Woman Average Number Introduced	Old Woman Total Possible Number Correct
3-4	1.14	16.29		2.14	16.57	
4-5	1.14	7.86		2.57	14.57	
5-6	1.71	3.22		3.33	3.44	
			2			4

	Critical Ratios
3-4 and 4-5	.39
4-5- and 5-6	1.48
3-4- and 5-6	2.18

*Average total number of notes sung, ages 3-4, 36.14, S.D. 16.40; ages 4-5, 24.14, S.D. 21.0; ages 5-6, 11.64, S.D. 8.29.

TABLE 5

ASCENDING AND DESCENDING INTERVALS OF SECONDS

Ages	Lady Bug Average Number Correct	Lady Bug Average Number Introduced	Lady Bug Total Possible Number Correct	Old Woman Average Number Correct	Old Woman Average Number Introduced	Old Woman Total Possible Number Correct
			Ascending			
3-4	4.14	3.85		2.42	2.28	
4-5	6.14	4.00		4.57	1.57	
5-6	12.42	3.00		7.11	0.44	
			13			9
			Descending			
3-4	2.00	4.85		7.42	4.29	
4-5	3.86	7.71		9.59	1.85	
5-6	5.66	2.11		16.55	.77	
			8			21

	Critical Ratios* Ascending	Critical Ratios* Descending
3-4 and 4-5	1.19	.63
4-5- and 5-6	1.18	.61
3-4- and 4-6	3.06	1.20

*Based on total number sung.

2. Analysis of intervals sung.--From an inspection of Table 4 it may be seen that the number of notes held decreases with age, showing that more distinctions have been made between the various notes at the older age levels, and also that progress is being made away from the monotone type of singing displayed more at the younger ages.

Table 5 demonstrates that the ascending intervals of seconds are more difficult than the descending intervals of seconds for the children to sing. These results are in keeping with those of previous investigators. The differences that are statistically significant are between the ages of three to four and five to six years, although the differences are more marked in the case of the ascending intervals. This fact indicates that the ability to sing ascending intervals is a measure of maturity in this function of singing. Both ascending and

TABLE 6

ASCENDING AND DESCENDING INTERVALS OF THIRDS

Ages	Lady Bug			Old Woman		
	Average Number Correct	Average Number Introduced	Total Possible Number Correct	Average Number Correct	Average Number Introduced	Total Possible Number Correct
			Ascending			
3-4	.86	1.86		2.00	2.00	
4-5	2.86	1.86		2.86	1.71	
5-6	3.88	.66		5.33	1.47	
			6			6
			Descending			
3-4	1.57	3.43		0.43	1.71	
4-5	2.57	0.85		0.85	2.00	
5-6	4.00	0.88		1.66	1.77	
			5			2

Critical Ratios		
	Ascending	Descending
3-4 and 4-5	0.98	0.50
4-5- and 5-6	0.86	1.45
3-4- and 5-6	2.01	0.60

TABLE 7

ASCENDING AND DESCENDING INTERVALS OF FOURTHS AND FIFTHS

Ages	Lady Bug			Old Woman		
	Average Number Correct	Average Number Introduced	Total Possible Number Correct	Average Number Correct	Average Number Introduced	Total Possible Number Correct
			Ascending Fourths			
3-4	.29	0.00			.14	
4-5	1.28	.14			0.00	
5-6	1.66	.33			0.00	
			3			0
			Ascending Fifths			
3-4		.43		.43	.43	
4-5		.28		.57	0.00	
5-6		.11		.77	.11	
			0			1
			Descending Fourths			
3-4	.48	.14		0.00		
4-5	1.28	.14		.43		
5-6	1.77	.33		.44		
			3			0
			Descending Fifths			
3-4		0.00		.43	0.00	
4-5		.28		0.00	.14	
5-6		0.00		.22	0.00	
			0			1

descending intervals of seconds increase in number with increase in age, however.

From inspection of Table 6, it may be seen that the case is approximately the same in regard to ascending and descending intervals of thirds. However,

TABLE 8

NUMBER NOTES REDUCED TO HOLDING SAME NOTE

Age Levels	Reduced From Intervals of Seconds		Reduced From Intervals of Thirds	
	Lady Bug	Old Woman	Lady Bug	Old Woman
3-4	5.0	7.42	5.57	1.42
4-5	1.71	4.22	1.14	1.57
5-6	1.33	1.66	1.0	.44

TABLE 9

NUMBER INTERVALS OF SECONDS REDUCED FROM INTERVALS OF THIRDS

Age Levels	Lady Bug		Old Woman	
	Ascending	Descending	Ascending	Descending
3-4	1.71	1.0	.86	.43
4-5	.71	.57	.43	0.0
5-6	1.56	.78	.11	0.0

it may be noted that the critical ratios in all instances are less differentiating in these cases than they are in the case of the intervals of seconds. This fact leads the writer to conclude that intervals of thirds are easier at all ages to *distinguish and produce than are the intervals of seconds.*

Table 7 demonstrates that there is also an increase in the ability to sing intervals of fourths and fifths with increase in age. Again, the descending intervals are found to be easier for the children at all age levels to sing. These results, however, are not as clear as the foregoing, probably because the incidence of intervals of these magnitudes are considerably smaller.

Table 8 represents the number of notes which were reduced to holding the same note. It may be seen that this practice decreased as age increased, and that more of the subjects at all age levels reduced intervals of seconds to holding the same note than intervals of thirds. Again, this is an indication that there is a greater distinction made by the subjects between *intervals of thirds* than between intervals of seconds. The greatest progress in differentiating between intervals of seconds comes between the ages of three and four, and thereafter the increase in this ability is slight.

Table 9 shows the number of intervals of thirds that were reduced to intervals of seconds. It may be seen that, again, the older subjects resorted to this less frequently than did the younger children. Fewer of the descending intervals of thirds than of the ascending intervals were reduced to intervals of seconds.

3. Range.--It may be remembered that the children were allowed to start the songs on any note that they wished in order to insure the fact that they were singing within their normal ranges. The range of notes which were used to start the song "Lady Bug" extended from middle C to A above. The range of notes used to start the song "Old Woman" extended from middle C to A#. The majority of subjects sang within the range from middle C to D# in both songs. Considering the fact that the song "Lady Bug" had a range of one octave, it may be seen that the voices of the subjects used in this investigation were very flexible. In most cases, however, the children appeared to be most comfortable when they sang at lower pitch levels.

4. Parents' and children's abilities to sing.--The respective parents' judgments of their ability to carry melodies were weighted on the basis of a rating

TABLE 10

TOTAL NUMBER OF NOTES SUNG INCORRECTLY ACCORDING TO SEX

	Girls			Boys			Critical Ratios between Girls and Boys
Ages	Average +	Average -	Both	Average +	Average -	Both	
3-4	19	77	99	37	50	87	.49
4-5	19	50	49	22	30	52	.06
5-6	00.33	3	4	8	27	35	1.77

scale as well as on the length of time that they studied singing outside of the school curriculum. The coefficient of correlation between the mothers' and children's abilities to carry melodies was .610 ± .09, that between the fathers' abilities and that of the children was .37 ± .115. The fact that the relationship which existed between the abilities of the mothers and those of their children to sing was almost twice as great as that between the fathers' and children's abilities suggests strongly the importance of the rôle played by environment in the learning process of this function. The mothers supply most of the musical environment for their children, and thus the child learns from the examples of the mothers' singing. The correlation found between the fathers' and children's abilities to sing approximates closely the relationship usually found between inherited physical traits. However, these results must not be regarded as being predictive in general for cases beyond the scope of this study, since the number of subjects used was so small. The problem is one of importance and interest, and merits further research.

5. Analysis of home musical backgrounds.--The relationships which existed between the home musical background as measured by the type of music generally listened to in the home, the amount of time spent by the parents singing with the children, the amount of time spent by the children listening to the radio, piano, etc., and the abilities of the children to carry melodies, was found to be relatively low, namely, a coefficient of correlation of .32 ± .14. Undoubtedly the chief factor that influenced this low coefficient is the homogeneity of the home backgrounds. No extensive research has been made of the problem, although it seems that the results would be very interesting.

6. IQ and CA in relation to ability to carry a melody.--The coefficient of correlation found between the children's abilities to carry melodies and their IQ's was .37 ± .14. Although this coefficient is relatively small, it is greater than that obtained by McGinnis (7) who measured the separate abilities involved in singing as found by the Seashore Tests. She found a coefficient of correlation of .25 between IQ and the separate abilities involved in singing. The fact that correlations obtained in this study are twelve points greater indicates that the ability to carry a melody at this age level involves higher mental processes than those involved in utilizing the component parts of singing.

The coefficient of correlation between the CA (chronological age) and ability to carry a melody, as would be expected, was higher, being .59 ± .00.

7. Sex differences.--The distribution of sexes at the different age levels was approximately equal. From an inspection of Table 10 it may be seen that no marked sex differences were observed, except possibly at the age level of five to six years. Here it may be noted that the girls were slightly superior to the boys. However, the cases included in this study were so few in number that no general predictions can be made from the results here obtained.

SUMMARY

1. The reliability of the method is shown by an average intercorrelation of .91 among the four independent transcribers, and by correlations of .87 between the second and the third trial and .91 between the third trials of each song.
2. The validity of the method is shown by a correlation of .72 between the evaluation of the children's ability to carry a melody and that of their parents; of .71 between the authors' and the teachers' evaluation of the same ability; of .96 between the qualitative and the quantitative analyses of this ability.
3. There is a definite increase with age in the ability to carry a melody.
4. The difference in the ability to carry a melody is most significant between the ages of three to four and five to six years.
5. The closer intervals in descending order are easier for small children to sing accurately than the ascending intervals.
6. A closer relationship exists between the abilities of the mothers and those of their children to carry a melody than between the abilities of the fathers and those of their children.
7. The correlation between the IQ and ability to carry a melody is .37.
8. *The correlation between the CA and ability to carry a melody is* .59.
9. There are no significant sex differences observable in any of the factors analyzed in this investigation.

CONCLUSION

Although one must expect great individual differences to be found in any study of special abilities, it has been shown that with increase in age in the average child there is an increase in the ability to carry a melody. It has been suggested that children who are exposed to richer musical environments show a greater and earlier ability to carry a melody than those children whose musical environments are poorer. In addition, the previous studies cited have shown that, by a specific training program, the initial abilities to sing may be much improved. Jersild and Bienstock (6) have shown that this improvement is a relatively permanent one. Jersild (4) has also found that of all the abilities that respond most to training, the ability to sing is the one which shows most striking results. It may be expected that through a program of instruction based on scientific findings designed specially for preschool children, much may be hoped for in the way of enabling many more young children to sing accurately and to make the most of their musical potentialities.

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COMMON CONTENT IN THE SPEECH OF PRESCHOOL CHILDREN

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The student of child behavior recognizes that there is considerable community of ideas, as expressed in speech, among children in nursery school groups. Children tend to talk about the same things and in much the same terms, but whether or not these common verbal responses are attributable to the cultural contagion of a common environment is hard to determine in a nursery school setting. Similarity in the verbal responses of children who have not enjoyed association with their peers except through informal neighborhood play may throw some sidelights upon the extent to which the cultural background of young children is standardized even in the absence of schooling of any sort.

The object of this paper, therefore, is to examine some of the responses commonly made by children between the ages of two and five, as to the frequency with which certain concepts are mentioned, the sex and age differences that obtain in the expression of them, and the function they may serve in the child's adjustment to his world. It is to be hoped that analysis will reveal which responses are common by virtue of their being expressions of common needs and wants of the child, and which are merely a product of early culturization; in other words, which are outgrowths from within the child's own body, and which are superimposed from without.

The records used in this analysis are diary-type accounts of the child's all-day visit to a health center in the course of which he is subjected to a number of examinations with periods of rest, play and a meal interspaced. The record contains a verbatim account of the child's speech during a thirty to forty-five minute play period, together with briefer notes on the child's behavior upon arrival at the Center, at examinations, at meal and at rest. These records are obtained at six months' intervals on each child on the occasion of his regular visits to the Center for Research in Child Health and Development.[2] Visits occur within a week of the half-yearly birth date; hence, there is no ambiguity in the age grouping of children.

For the present study 336 such records of the child's day are used, 168 of each sex, distributed by ages as follows: 20 records at two years, 40 at two and one-half, 50 at three, three and one-half and four years, 60 at four and one-half and 66 at five years. No age level is entirely discrete as to personnel, however, as there are from one to four records on each child. Hence, the records of a given child may be tabulated at four successive age levels. Because of this overlapping of cases, age differences will not be emphasized in the discussion.

The technique employed in this analysis is simply that of listing the concepts or words that are most commonly found in the records, then of abstracting on cards the context in which that concept or word was used. A card is made for each of the common concepts found in the record of a given child.

Even though the child may have used a given word many times, it is counted only once per record, except in cases where a second usage differs markedly in context from the first. A number of words, particularly those referring to mother and home, were used both in straight-forward exposition and with emotional connotations. Such words are recorded twice per record, once for the emotional and once for the non-emotional context. For example,

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[1] From Center for Research in Child Health and Development, Department of Child Hygiene, Harvard School of Public Health.

[2] For a more complete account of the activities of this Center, and the specific conditions under which the observations were made, see Publication No. 1 of the Department of Child Hygiene, Harvard School of Public Health (2).

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a child may say, "I had one like this, but it's broke. My mother is going to buy me a new one." This bit of conversation furnishes four common responses: one for recognizing a familiar object (one like this) and one each for reference to "break", "buy" and "mother". If the same child later says, "I want my mother to come take me home," the word "mother" is again recorded, because the child's usage indicates that his utterance is an expression of insecurity in the absence of the mother, rather than a matter-of-fact informative reference to her. If in the same record, the child inquires, "Who broke this?", the query is added to the original card for "break", but this response is not counted a second time for that record, since the second usage differs little from the first. This prevents a common response from obtaining a high frequency of usage merely by virtue of its being reiterated time and again by the same child. For the measure of commonness of a response is the number of children who use them, not the extent to which it is used by a single child.

Number of Common Word-Concepts and Expressions: In all, 50 different word-concepts occur frequently enough to warrant tabulation, and the records yield 1,502 tabulations under these headings. Almost a third of these are attributable to four word-concepts: mother, father, sibling and home. It is at once apparent that these family word-concepts belong in a class by themselves, not only because of their highly common usage, but because of their great emotional significance to the child.

Sex differences in usage of concepts are obscured by the fact that the girls are far more talkative than the boys in this situation. Exclusive of references to family concepts, the girls used 1.4 times as many common concepts as the boys (total concepts: girls, 633; boys, 457). Greater common content in the speech of the girls seems to occur not because their speech has less variety than that of the boys, although this is a possibility, but because they make more utterances in the same unit of time. As a method of equating the sexes in loquacity, the raw frequency of word-concepts for the boys is multiplied by the factor 1.4. In the use of family concepts, the discrepancy between the sexes is not so great (total concepts: girls, 222; boys, 190). There is no reason to believe that the boys are not equally laconic in all their speech; on the contrary, there are good grounds for supposing that the boys' greater freedom in the use of family concepts is an expression of their greater insecurity and emotional need. Hence, the 1.4 correction is applied to these concepts also. The degree of correction is far more conservative than it would have been if based on the number of words or sentences uttered, for the girls utter many more words per sentence, and more sentences per play interval than is indicated by the 1.4 correction.

Frequency and Sex Differences in Frequency of Concepts: The 50 common word-concepts classified under functional headings are listed in order of frequency of usage in Table 1. The first column gives the total uncorrected frequency, the second, the frequency for girls, and the third gives the corrected frequencies for boys. Raw frequencies for the boys may be computed by subtracting girls' frequencies (column 2) from totals (column 1). The last column represents the ratios of the corrected boys' frequencies to those of the girls and thus furnishes a rough indication of the significant sex differences.

The table is worth scrutiny both for the order of frequency of the responses and for the sex differences it reveals. The word "mother" tops the list with more than twice as many usages as any other word. The interesting fact here is not that "mother" is mentioned by the majority of the children, but that in 51 records for girls and 30 records for boys, the mother was not mentioned during the day; more girls than boys evince this type of independence of the mother.

TABLE 1

WORD-CONCEPTS COMMONLY USED BY CHILDREN TWO TO FIVE YEARS OF AGE

Word-concept	(Based on 334 records)			
	Total Usages (uncorrected)	Girls	Boys (corrected)	CB/G
1. Mother	208	117	130	1.11
2. Negations	89	26	90	3.46
3. Sibling	83	52	44	.78
4. Make-believe	77	35	60	1.71
5. *Proper names*	64	39	36	.92
6. Attention-calling	63	39	37	.94
7. Home	62	25	53	2.12
8. Question - What's this?	62	27	50	1.85
9. Size - big	60	35	36	1.03
10. Father	59	28	44	1.26
11. Cry	56	27	41	1.52
12. Size - little	43	23	29	1.26
13. Cleanliness	41	30	17	.56
14. Clothes	40	30	14	.47
15. Excuses	38	22	13	.59
16. Break	34	17	24	1.41
17. Buy	32	17	21	1.13
18. Numbers	32	18	20	1.11
19. Other child present	31	18	18	1.00
20. Possessives	29	22	10	.45
21. Help, give	27	20	10	.50
22. Help, seek it	26	20	9	.45
23. Permission	26	15	15	1.00
24. Illness	22	20	3	.15
25. Information	21	7	20	2.86
26. *Familiar objects*	19	11	11	1.00
27. Undress	16	9	10	.90
28. Direct others	14	8	9	1.12
29. Memory	14	10	6	.6
30. Seek security	12	7	7	1.00
31. Express enjoyment	11	7	6	.86
32. Beg	11	5	9	1.8
33. Mother of another child	10	7	4	.58
34. Tattle	8	7	1	.14
35. Beauty	8	6	3	.50
36. Fear	8	7	1	.14
37. Fixation	7	4	4	1.00
38. Ownership	7	2	7	3.5
39. Sex differences	7	5	3	.6
40. O'clock	6	3	4	1.3
41. Seasons	5	4	1	.25
42. Weather	5	3	3	1.00
43. Personalities	5	3	3	1.00
44. Objections	5	5	0	----
45. Money	4	0	5	----
46. Self-praise	4	3	1	.33
47. *Grow up*	3	0	4	----
48. Independence	3	1	3	3.00
49. Week-days	3	1	3	3.00
50. Threat	2	0	2	----

Refusals and negative responses stand second in the list by virtue of their frequent usage by boys; they occupy rank 12 for the girls. Boys give vent to negative expressions thrice as frequently as girls.

Sibling, home and father are among the ten most frequently mentioned concepts; siblings[3] are referred to more often by girls, but home and father are mentioned oftener by boys.

The high frequency of make-believe or fantasy concepts is to be expected at preschool ages, but it is a little surprising to find boys verbalizing their dramatic play more readily than girls.

The concept that every person has a name arises early in childhood, but the child's application of names to adults and children whom he knows only in the clinic situation depends both upon his intellectual grasp and his social poise. The child who is ill at ease seldom calls the adults or other children by name. Sex differences in the use of proper names are negligible. The category of proper names is fifth in the list of common responses.

The words "lookit," "see," and "Watch what I do," all classified as attention-calling, also have a place among the ten most frequent responses. Boys and girls differ little in the extent to which they call the observer's attention. The naming question, "What's that?", which occurs with practically the same frequency as the attention-calling response, is considerably more frequent for boys. This question is often rhetorical and is asked for the sake of getting attention, since the child often answers it himself in the same breath.

The word "cry" occupies rank 11 and is somewhat more frequently used by boys than by girls.

References to sizes, big and little, occupy the 9th and 12th positions respectively; "big" is used more frequently by both girls and boys, and the child most often applies it to himself, as "I am a big boy," and to his possessions and activities, as "I have a big truck at home"; "I'm going to eat my big orange"; and "See the big train I made. A big, big one." These children seldom apply the term "little" to themselves or to anything they have or do; instead they use it to refer to other children, regardless of their age or size, as "My yitta bubba" (little brother), used by a two-year-old to designate her four and one-half year sibling, and "I can hear somebody cryin', She must be little." They also use "little" in referring to neutral objects, as "There used to be a little gas pump here."

In short, the eleven most frequently used word-concepts all seem to carry an emotional charge for the children. There is a rather marked gap in frequency of usage between the words "cry" and "little". With the latter begins a list of words fairly neutral in emotional connotation that extends, with some exceptions, through the remainder of the list.

The two concepts that occupy positions 13 and 14, cleanliness and clothes, are of interest because they are mentioned about twice as often by girls as by boys. Girls make excuses, invent alibis and make rationalizations about their behavior more often than boys (item 15). They are more often possessive, saying, "This is mine" about the playroom toys that are to be used by all children (item 20). Girls also exceed boys both in offering to help others (item 21) and in appealing for help from others (item 22). Perhaps the most interesting sex difference of all is that in mentioning illness (item 24). References to their own illnesses or to the ills of their family or friends were found in only three records for boys but in twenty for girls. In fact, several little girls dwelt at length upon the ailments of grandparents, neighbor children, and gave every indication of being considerably worried about the sickness of others. Other types of speech used more often by girls than by boys are tattling (item 34), aesthetic concepts (item 36), expressions of fears, real or imagined, (item 36) and the concept of sex differences (item 39). Under the last heading are classified such expressions as "Hey, these airplanes are only for boys, ain't they?" Such expressions suggest that girls become conscious of the accepted sex mores at an earlier age than do boys. This list suggests that the typical feminine conversational interests begin to appear in the speech of girls even at the preschool ages. Clothes, dirt, ailments, solicitude, appearance, gossip, temerity and the opposite sex have been recognized as forming the bulk of women's small talk from ages untold.

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[3] The records of 73 children of each sex entered into this analysis. The number of children having one or more siblings was approximately the same for each sex. Nineteen boys and eighteen girls lacked siblings, and hence had no opportunity for mentioning brothers and sisters.

Boys' conversational interests are less clearly defined. They show a lead over girls in most of the first eleven emotionally-charged responses, and a definite lead in offering gratuitous information. They say "This is broke" or ask "Who broke this?" a little more often than girls. They also lead very slightly in the concept "buy"; the four references to "money" were all made by boys; they made more inquiries about the ownership of various toys in the play room, and more of them begged for a toy to take home. Hence, there is a slight indication that economic concepts begin to play a part in boys' conversation earlier than in girls.

Further analysis and speculation must be deferred until the contexts of the usages are described more fully.

Emotional References to Family: The high frequency of references to mother, father, sibling and home occur partly because the children use these concepts in expressing their insecurity. The number of insecurity responses to each of these words is given in Table 2.

Children use the words "mother" and "home" more often to express their insecurity than to give information, whereas they more often speak of the sibling and the father with matter-of-factness. For each of these four words, boys have a higher number of responses indicating insecurity than girls. Girls exceed boys in number of informative references to the mother and sibling; boys exceed girls in number of informative references to the father and to the home. These sex differences would be of only passing significance were they not in such perfect accord with other evidences of the boys' excessive insecurity in the absence of the mother.[4]

Developmental trends in these responses can be presented far better by illustrations than by classification and generalization. With the two words most highly charged emotionally, home and mother, insecurity references predominated up to the age of four years; thereafter, informative responses became more common. Some typical examples of the insecurity references, age by age, are given in Table 2.

The terms in which insecurity references are couched shows marked development during the three-year span from two to five years. The two-year-old of either sex characteristically expresses insecurity by the single word "Mamma," or by calling the sibling's pet name in case he is present. Home and father are not even mentioned at these ages.

At two and one-half the insecurity response is elaborated by the word "want" as "Want Mamma" or "Wanta go home," and sometimes by the question "Where is?" or "Where went?" The child's feeling of insecurity is entirely of the immediate present, and at this stage assurance that he will, in the near future, return to the haven of home and mother is of no avail. By three

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[4] Evidence confirming this statement is to be published by the author in a forthcoming monograph of the Society for Research in Child Development.

TABLE 2

INSECURITY REFERENCES TO MOTHER

Age	Girls	Boys
2 yrs.	Cried, "Mamma, Mamma."	Called, "Mamie," showing no interest in play.
2½ "	"Where my Mamma go? Want to see Mamma."	"Want my Muddah."
3 "	"My Mother coming over and get me after my nap?"	"Momma coming back pretty soon?"
3½ "	"I wish my Mummie would come take me home."	"My Mamma be up after me in two more minutes; I want to stay right here where my Mamma can find me."
4 "	"Teacher, teacher, is that my Mother downstairs?"	"I want to look out the window and see if my Mamma's coming."
5 "	"When is my Mother coming?" "Wish she would hurry up and come."	"I wish my Mother would hurry up and come."
	"My Mother's going to say, 'Where's my child?' and Carol's going to say, 'Where's my sister?'"	"I don't want to rest. If Mother comes, she won't know where to find me. She'll ask the lady who washes dishes, 'Have you seen a big boy?' and that'll be me; and she'll say, 'Yes, he's upstairs,' and she (mother) will come get me."

INSECURITY REFERENCES TO HOME

2 yrs.	None.	None.
2½ "	"I want to go home."	"I want to go home for my dinner."
3 "	"I want to go home, 'cause my Mummie's crying'."	"I want my Mammee come home now." (to come home to my Mamma)
4 "	"When you going to take me home?"	"I want to go home. My Mother wants me."
5 "	"I want to go home when it's night."	"I want to go home to eat."

INSECURITY REFERENCES TO SIBLING*

2 yrs.	Called, "Bubba; Bubba," (brother)	Called, "Minkie, Minkie," his nickname for sister.
3 "	"Where sista go?"	"Woofie (sister) come up 'tairs?"
3½ "	"Mary will come, won't she?"	"My brother, he here too."
4 "	"Hey, Tom, come on over here."	
4½ "	"Oh, I've found Leo" (brother).	"Where went Julladeen?"
5 "		"What if Dougie come up here and we weren't here?" (child had been asked to go downstairs)

INSECURITY REFERENCES TO FATHER

Insecurity references to the father did not occur in either sex at two or at five years. At all ages between, the references were simply:

"I want Daddy."
"My Daddy is coming for me."
"When will my Daddy come?"

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*Such references occurred only when two siblings were present at the Center together; hence twins and siblings whose semi-annual birthdays fall within a week are the only children who have an opportunity for this type of response.

years, however, the child's concept of futurity has developed sufficiently to enter into his feeling of insecurity, and he inquires, "My Mother coming?" The time element plays an increasing part in the child's speculations about his mother's coming, and he employs the words "when" and "what time," "soon," and "hurry" to express his impatience for her arrival. Watchful waiting for the arrival of the mother occurs at earlier ages than four years; for children of two and one-half sometimes stand disconsolately gazing out the window. Not until four years, however, do they verbalize their motives by saying, "I want to watch for my mother."

Fear lest the mother or sibling might come and not find the child was expressed by a boy at three and one-half and by three others at five years; no doubt the same fear, though unverbalized, prompted other children's objections to leaving the playroom or their preference for sitting in the waiting room, rather than going outdoors to play with other children. At five years there are interesting examples of predramatization of the mother's coming by one child of each sex. In each case the child anticipated in imagination far more tender concern on the mother's part than she evinced when she came. Such imagined greetings suggest that these two children may feel somewhat rejected by their mothers, or at any rate, that they desire more expressions of affection from the mother than they are getting. In contrast with these two rather pathetic instances, there is one example of an over-dramatic mother-daughter greeting at the same age. The child rushed into her mother's arms with ecstatic cries, "Hello, Mother dear!" and the mother clasped the little girl saying, "Hel-lo, dar-ling!" in the appropriate Hollywood inflection. If the scene had been rehearsed in advance, it could not have been more patently "staged." Were corroborative evidence lacking (it is not), this incident alone would have sufficed to show that both mother and child were living in a cinema dream-world with Shirley Temple as their model and inspiration.

Though the verbal expression of insecurity changes with age and increases in complexity as the child's command of the language and his grasp of concepts of time and space improve, there is little evidence that his feelings of insecurity are any less real and acute at the later ages. To be sure, some children develop a sense of self-reliance and apparently lose all feeling of insecurity before the age of five years. For those children whose feeling of insecurity persists, it seems to exist at the same degree of severity, or even to increase, because they become increasingly aware of their own helplessness and better able to imagine dire outcomes of their temporary separations.

Non-emotional References to Family: The children refer to the parents in a variety of other ways, the most frequent of which are given in Table 3.

TABLE 3

NON-EMOTIONAL REFERENCES TO THE PARENTS

Type of Reference	References to Mother			References to Father		
	Girls'	Boys' (corrected)	Total	Girls'	Boys' (corrected)	Total
Parent as a provider	9	6	13	4	3	7
Parent as disciplinarian	12	6	16	0	0	0
Parent as providing routine care	5	0	5	0	0	0
Parent as providing recreation	0	0	0	5	7	10
Matter of fact statements	11	9	17	6	6	10
Father's work	0	0	0	4	9	10
Parent as an alibi	4	7	9	1	0	1

The parent is mentioned in the role of a provider a total of 20 times. Most of these statements are of the type "My Mother (Father) is going to buy (bought) (brought) me a train (ice cream, puppy)" or "Mother made my dress (coat)"; "Father made me a table and chairs (whimmin' pool)." There are 26 matter-of-fact statements about the parents; those referring to the mother concern her whereabouts or what she is doing at the moment: "My Mother is at home (at Gramma's)"; "My Mother always boils eggs." At later ages they are more informative, as "My Mother lived in Maine when she was a little girl." Those to the father are of the same type, with the addition of references to things he does and does not like to eat. Mother's food fads, if she has any, go unmentioned.

Mother alone is referred to as a disciplinarian, and twice as many girls as boys mention her in this capacity. The disciplinary reference usually is to an admonition, real or imagined, not to get dirty, the most extreme one being "My Mother'll kill me," (the child had found a spot on her coat). Four children referred to the discipline of a sibling or of another child: "My Mother spanks the daylights out of Bobby." Of the references made by boys, two were the mild statement: "My Mother never lets me pour at the table"; one was the statement, "Her Mamma's spankin'" upon overhearing another child cry; and the other was the statement that "Mother says the piano is just for Ann," implying that the child had been admonished to keep hands off his sister's possessions. One boy boasted at some misdeed, "My Mother won't touch me." The girls' more frequent references to the mother as a punisher offers fragmentary evidence, but it suggests either that mothers are firmer with girls or that the girls take the mothers' admonitions more seriously.

It is perhaps significant, too, that fathers are never mentioned in the role of providing routine care: "My Mother made my curls (feeds me, brushes my teeth)"; and mothers are never mentioned in the role of providing special excursions or recreation: "My father reads me stories (took me to the park, takes me fishin', fwimmin', coasting, fished me out of a pond when I fell in a long time ago)." Mother, it would seem, provides the necessities; father provides the luxuries and pleasures, from the child's point of view. This fits the division of labor of child care as it is worked out in most American families.

A further bit of evidence that corroborates the statement that boys are more interested in economic matters than girls is their more frequent references to the father's work. Most of these are simple statements: "My Daddy has gone to work" or "My Father is working now," in contrast to being unemployed, or "My Grandmother (the father-surrogate in a family where Mother and Father had been separated) works as a waitress." Two boys referred to the father's lack of ability to provide cars for the family in these ways: "My Father hasn't a car, so he borrows everybody's car"; "My Daddy works, too, out in the street. His car's in the g'rage. He's not any money to take it out." Work, money, buy and borrow are early forming concepts in these preschool children; and it seems probable that the more precarious the family's economic condition, the more readily the children learn these simple economic principles.

Making a scapegoat of the parent in an effort to get out of doing a distasteful act is one of the clever types of usage of the word "mother." The child says, "My Mother doesn't want me to sleep (eat, drink) here." "My Mother lets me spit out my tomatoes." "You were my boss, but now my Mother's here, and you're not my boss any more." Only one child mentioned the father in this way, saying, "My Father doesn't want me to get undressed -- to get measured." A few children use the mother as a threat to other children: "My Mother says don't do that!" "I'll tell my Mother on you." Thus, the child uses the absent mother as a barrier between him and an adult or child who, he feels, threatens his security or pleasure. There are a few references to helping mother: "I help my Mother, but I won't help you"; "I sweep the floor for my Mother and do everything for her." A four-year-old boy gave an amusing example of desire to share with the mother. He came to the play-yard with four pieces of candy saying, "One for me and one for Priscilla; and one for my Mother and one for Priscilla's mother." He gave a piece to Priscilla, ate one, reserving two; presently a second piece found its way to his mouth, and he rationalized his cupidity, "One left for my Mother; Priscilla's mother won't know I had any candy."

Other ways of referring to the parents are to their possessions: "My Mother had a p'ato masher like this"; "My Daddy has a truck." Some refer to the mother as an authority in point of fact; "My Mother says it's ten o'clock." "My Mother thought it might snow." Others refer to the mother as an exemplar, as "I wipe my hands like Mamma," and "My Mamma doesn't make a cake (cook fish) like that," the implication being that Mamma's way is better. A few announce their intentions of telling Mother about their day, as "I'll tell Mother I didn't cry when I was weighed," or of deceiving her, "I'll tell Mother I did cry," when he hadn't.

These parent references on the whole are free from emotional undercurrent, and the usages fit in with the commonly accepted appropriate roles for mothers and fathers to play in the children's lives, Mother as provider of comforts and discipline, Father as breadwinner and provider of simple pleasures.

The children refer to their siblings in only about four different ways (See Table 4). Their most common type of reference is a matter-of-fact informative statement: "Betty's at school"; "You know I got a little baby home and he can stand alone"; "Sister wanted to come with me"; "Junior's birthday's in June."

TABLE 4

REFERENCES TO THE SIBLING

Type of Reference	Girls'	Boys' (corrected)	Total
Matter-of-fact information	19	14	28
Protective or affectionate references	3	7	8
Siblings' misdemeanors	7	1	8
Siblings' possessions	5	1	6

References to the sibling in an affectionate or protective way were made more frequently by boys than by girls. They included such items as: Don't get my sister dirty, or I'll knock your head off"; "Who's crying -- not my brother?" "Want to go see Mamma, Honey?" was a remark made by a four and one-half year-old girl whenever her little brother's tears subsided, and he became engaged in play. The attendant was unable to decide whether the girl was trying to be solicitous or was being wantonly cruel. References to the siblings' possessions and to the siblings' misdemeanors were made more often by girls. They included such items as, "My Mary sucks her thumb";

"Tom puts grease on himself"; "My sister has a piano, but she never plays it"; "Tricia's a fresh thing."

The sex differences are really too slight to be of much significance, but they suggest that sibling rivalry plays a slightly greater role in girls' lives than in boys'.

The word "home" was used in only two ways by the children, in addition to its emotional usage. Home is conceived by the child as the place where he keeps his possessions, as is indicated by such references as, "I have a good bike at home"; "I want to take this (paper napkin) home with me"; "I got better blocks than these at home." The second, and less frequent type of reference is to home as a place to which one returns, as "Every time I go home, I lay down"; "When I get through kindergarten, I'm going to stay home." Home is a retreat, and home is where one's treasurers are.

References to Crying: The word "cry" has two very different types of usages according to whether the child employs the word in reference to another child or to himself. Reference to the crying of another child is either a matter-of-fact comment, such as "Girl crying; girl mad!" or an equally matter-of-fact question, "Who is crying?" "Why is he crying?" When the child uses the word "cry" in reference to himself, it is usually to boast, "I didn't cry." Occasionally a child confesses, "I did cry," or threatens, "I will cry." Frequencies of these responses are given in Table 5.

TABLE 5

REFERENCES TO CRYING

	Girls'	Boys' (corrected)	Total	CB/G
Comment on cry of another	16	21	31	1.3
"I didn't cry."	9	18	22	2.0
"I did (will) cry."	2	2	4	1.0

Boys use the word "cry" one and one-half times as frequently as girls. They refer to the crying of another child one-third more often than girls, and they boast about not crying twice as often as girls. Indeed, boys' usage of the word indicates a growing intolerance of crying and an impatience with those who give way to their feelings in tears. They say:

2 yrs.	"Crying" with some sign of distress upon hearing outcry of another.
2-1/2 yrs.	"Hear baby cry. Mama's 'panking."
3 yrs.	"Who's that crying? My sister don't cry."
4-1/2 yrs.	"I'm not going to stay here and listen to him cry. Isn't he a crybaby?"
5 yrs.	"I could hear her screeching upstairs!"

In their boasting responses, boys say:

3 yrs.	"I'm a big boy, I don' cry." "I don't cry. Only Billy cries."
4-1/2 yrs.	"It hurt, but I didn't cry." "I don't cry when I go on a swing or when I fall down." "I didn't cry and you did!"
5 yrs.	"He's going to cry when you do that. I screamed before, but not this time.

The girls' usage of the word "cry" seems to be tinged with a little more sympathy for the child in distress. They ask the reason for the outcries or try to give a plausible excuse for the other's child's crying. Examples follow:

2 yrs.	"That baby is crying for me!"
2-1/2 yrs.	The cry of a crippled child who was being fitted with braces was overheard. The little girl asked, "Why is that boy crying?" She was much interested in the explanation that was given her, and later she told her mother, "A little boy was crying, because he had a sore foot."
4 yrs.	"He's crying because he wants to come out here."
5 yrs.	"She's crying 'cause she doesn't want her dinner." "I can hear somebody crying. Not that big girl. She must be little."

The boasting responses of girls, "I didn't cry" are much more similar to those of boys, but are made much less frequently. These differences in the usage of the word "cry" suggest that the cultural pattern of "grin and bear it" is imposed earlier and more thoroughly on boys than on girls. Boys' greater frequency of boasts about not crying is interesting in light of the fact that boys cry more frequently than girls at being separated from the mother and at arriving in the playroom; but they cry less frequently than girls at the blood test.

The "I don't cry" response as given by these children begins at three years, thus coinciding with the age at which Murphy (1) obtained it in her study of sympathetic responses of nursery school children. Murphy found the response spreading in the nursery school group, apparently from cultural contagion; the response was started by a little girl of considerable daring and prestige and was taken up by other members of the nursery school. Results from this group indicate that although the response is far from universal, it does occur as a common response among children who have not been subjected to a common environment. In so far as the response is culturally determined, therefore, it acquires its commonness among these children because of the parents' common standards of child behavior.

Make-believe Play: Dramatic conceptions fall into two types, a very simple type, comprising mostly imaginative references to food, such as, "I'm making a cake"· "I'm making a cup of tea"; "Do you want a cup of coffee?" Most of these simple imaginative utterances occur during sand play and are stimulated by the tea set, spoons and other cooking utensils for use in the sand. Simple imaginative references to garages, trains and block structures are also included in this group. These simple dramatic references are more frequently made by the boys. The more complex dramatizations are oftener made by girls, probably because they are usually associated with doll play. They include such items as, "My baby must wear a hat, so she won't catch cold." "Toys for sale, toys for sale; twenty-nine cents!" "I'm going to be the man who sends his tax." "What could be the table?" (A table that was in full view was pointed out). The child rejected this suggestion and chose instead a ladder-step as her table, saying, "Well that (table) *could* be the table, but this (ladder) *will* be it." The joy of make-believe is in the pretense, not in the similitude to reality.

Names: Correct usage of proper names is one index to the expansion of the child's social world. Only a few children under four and one-half years use the name of another child in addressing him. A few children learn and use the names of staff members by the age of four years. At three and one-half and four years, a number of them also speak of their absent acquaintances by name saying for example, "Larry can't go to Sunday School, 'cause he's naughty and bad." "Do you know Smithers out in Woxberry? He sells ice cream cones." "Do you know Sonny Shotlum?" Place names such as Roxbury, Dedham, Plymouth, Franklin Park, New York, also begin to play a part in the speech of children in the fifth year. Children of wider social experience, such as nursery school children enjoy, would unquestionably use proper nouns more freely than these children did. The nature of the child's references to absent persons suggests that at the early ages he expects his conversant to be acquainted with all the persons he knows. This childish attitude is not far different from that of the adult who says, "So you're from Chicago! You don't happen to know the John Smiths, do you?"

Excuses: Rationalizing, presenting alibis and manufacturing excuses usually is regarded as rather an adult device for escaping from something unpleasant. This study indicates that the child is clever enough to think up plausible reasons for doing or not doing an act as soon as he has sufficient command of language to talk in sentences. Five children of two and one-half years and twelve of three years invented excuses for themselves. One little girl of two and one-half said, "I'm going to take this dolly home." When she was told she could not have it, she appealed on behalf of her baby brother saying, "But Gerard would like this dolly." At three years a child who was being detained upstairs said, "I want to go downstairs, 'cause that baby is crying for me." The most frequent excuses for avoiding examinations were: "My Mamma don't want me to be undressed" or "measu'ed" or "pricked," and the familiar toilet dodge. Excuses for not eating the food that is offered are the "It is too hot" or "cold" of fairy-tale fame. By four years the children are even more clever at veiling their true motives. A boy who did not want to play replied to a suggestion, "That makes too much noise. It might worry the babies downstairs." A girl of four and one-half said to each play suggestion, "My Mother doesn't want me to go near the sand in my clean dress." "My Mother doesn't want me to ride a bike, because I might get hurt." A boy of the same age said, "I want this window up, 'cause I want fresh air" when he actually wanted to lean out to watch for his mother's arrival. A five-year-old boy who had made a scatterment of toys said, "I can't pick up anything, 'cause I got a cold." It is an alert adult who can outwit even the preschool child by convincing counter-arguments.

Common Responses as an Expression of the Child's Needs:[5] The word-concepts and expressions most commonly used by these children seem to be expressions of fundamental needs. The need for security as expressed in his desire for home and family, in his requests that a staff member stand in loco parentis and in his demands for help accounts for about 16.5 per cent of the total number of common responses. Negative responses (No, I won't; I don't want to), excuses, desire not to be undressed, and declarations of independence (I can do it myself) are expressions of the child's need for autonomy and independence and of his need for harm-avoidance. These four categories comprise 9.7 per cent of the total number of common responses. In calling the adult's attention to his activities, and in many of his questions, the child is expressing his need for recognition, and in some cases, his need for exhibition. His need for affiliation finds expression in his use of proper names and in his reference to his companions of the day. These last two needs each account for approximately 6.3 per cent of all the common responses.

The child's need for nurturance is expressed in his references to helping mother and other children, and in some of his sympathetic references to the crying of another child. This need was expressed in about 4 per cent of the common responses. The need for blame-avoidance and for a super-ego is seen in a number of the responses of seeking permission, and in some of the usages of the word "cry" (I didn't cry.). These also amount to about 4 per cent of the total common responses. Reference to size, particularly to bigness is perhaps an expression of the child's need for achievement and mastery. It accounts for another 4 per cent of the common responses. About 20 per cent of the responses serve an informative function and perhaps may be considered as an expression of the child's need for exposition.

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[5] The needs employed in this analysis are taken from the list compiled by Dr. H. A. Murray, Jr. and obtained from him in manuscript form.

According to this sketchy analysis, at least 50 per cent of the common responses made by these children are an expression of his fundamental needs. More detailed analysis undoubtedly would increase this percentage, rather than diminish it. In the particular situation in which these observations were made, namely an all-day visit to a health center during which the child was separated from his mother and subjected to a number of examinations, the most important need is for security or succorance; and the second most important need is for autonomy and independence. Judging by relative frequency in common responses, children strive first for help; if it is not forthcoming, they then strive to stand on their own feet.

Common Responses as Imposed by Culture: The case for common cultural heritage as a basis for the development of common concepts is less clear-cut, largely because only one cultural background is represented by the children in the group. The influence of cultural impact may be seen in the large number of non-emotional references to the family. The point that the differences in types of reference to the father and the mother correspond to the commonly accepted concepts of their respective roles in child care has already been made.

Perhaps the marked sex differences in references to cleanliness and clothes may be laid at the door of a culture that imposes a "sugar and spice and all things nice" deportment upon little girls, but that brands the same standards of personal tidyness in boys as "sissy". The girls' greater morbid concern over illness, however, is less clearly imposed by culture, unless this be an outgrowth from the nurturant attitude that is fostered by doll play. It seems equally justifiable in the present state of our knowledge to attribute the sex differernces in these three common responses to a complex of needs that are stronger in girls than in boys; in other words, to a biological sex difference, rather than to a culturally conditioned one. The degree to which common cultural impact determines the common verbal responses of unacquainted preschool children could be determined only by obtaining responses on a group of children of different cultural backgrounds.

Summary: Analysis of the verbal responses of preschool children who are not subjected to the common environment of a nursery school reveals a large number of commonly used words and concepts. At least half of these, and probably more, seem to arise out of common needs of the children. Another 20 per cent of the responses are largely expositional. What proportion of the responses arise out of common cultural background is undetermined.

In the particular setting in which these responses were obtained, the word most frequently used was "Mother" and other words referring to home and family had high frequency. Sex differences were marked in negative expressions, wherein boys exceeded girls, and in references to clothes, cleanliness and illnesses, wherein girls surpassed boys. The need most commonly expressed was for succorance or security, and that second in importance was for autonomy or independence; the needs for affiliation and for recognition tie for third place, and those for nurturance, blame-avoidance and achievement tie for fourth. It is probable that this hierarchy of needs obtains only for preschool children when they are subjected to conditions similar to those of this study. Common needs of childhood offers a more clear-cut explanation of common responses than does common cultural impact.

A knowledge of the common verbal usages of preschool children is of value not only for studying common elements in child nature and in its environment, but also for judging the degree of idiosyncrasy of an individual child's responses. A child that has a large number of common responses differs greatly from one who has few; and the child who employs common responses in a manner counter to that of the group, as for example, the boy who refers to himself as a "little boy" and to "the big, big world" when other children commonly apply the word "big" to the self is highly individualistic to say the least. The possibility that further analysis of common responses as they occur in free conversation might lead to frequency tables that could be used in diagnosis of personality distortions makes this method worthy of further exploration.

REFERENCES

(1) Murphy, Lois B.: Social behavior and child personality. New York, Columbia Univ. Press. 1937. Pp. 114, 230 - .

(2) Stuart, Harold C.: The center, the group under observation, sources of information, and studies in progress. Society for Research in Child Development, Monograph Series, (In press).

DEVELOPMENT OF IMMATURE BABIES DURING THEIR FIRST TWO YEARS

MARY SHIRLEY[1]

Observers of the psychological or "mental development" of prematurely born children have come to a variety of conclusions: that the effects of prematurity on mental growth last as long as five years, that the effects of prematurity disappear by five months, that weakling prematures are not worth the rearing, that prematures exhibit mentality of the highest type, that children of birth weights under 1600 grams do not develop normal intelligence, that the proportion of mental defectives is practically the same for prematures as for the general population. These statements represent extremes of the findings of various investigators. The truth probably lies on some middle ground. All observers are agreed, however, that the prematurely born baby is psychologically under-developed at birth, and that he is especially subject to trauma at birth that may leave permanent cerebral or other neurological defects. Does this decrement of prematurity persist throughout life, or does he overcome his birth handicap; and if so, how early is he able to overtake the normal baby of his own birth age?

The divergent answers that workers have rendered to these questions probably are traceable in part to the examiners' inability to obtain early and frequent observations on a sizable group of infants. Gesell's (4) pronouncements are based on frequent cumulative records obtained on relatively few children. Those of Bradner (2) are based on a large sampling, but the children are of school age at the time of testing. Mohr and Bartelme (8) likewise report on a sizable group, and utilize both the Gesell and the Kuhlman-Binet tests, but their age range at testing is from eight months to seven years. Melcher (7) tested her 42 cases prior to eighteen months, using the Bühler-Hetzer scale, but her cases range in age from one and a half to nineteen months at time of testing. The developmental quotients she reports seem to be decidedly high for babies of lower middle-class parents, for 8 of the 42 cases rate 120 and above, as against 2 cases of 80 and below. Her developmental quotients do show an upward trend with age, however, which is the phenomenon one would expect if the babies are developing at an accelerated rate that enables them eventually to catch up with term babies of their own birth age.

The data about to be presented represent one aspect of a study[2] of prematurely born children, (i.e. children of birth weights under five pounds) wherein the babies are brought to the Center at intervals of three months for psychological, pediatric, anthropometric, orthopedic, and roentgenological examinations. The observers have as a basis for comparison data obtained under similar conditions on approximately 250 babies[3] born at term.

Psychological examinations have been given to 63 babies of sub-normal birth weights, 27 boys and 36 girls. In all, 215 examinations have been given; 17 children have been given 5 tests each, and 16 have had 4 tests, spaced at three month intervals from six to eighteen months. Only eight cases have failed to return for at least one subsequent examination. Although the observations show a number of undesirable gaps, nevertheless they represent a more complete series during the early period than has yet been reported.

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[1] From Center for Research in Child Health and Development, Department of Child Hygiene, Harvard School of Public Health.

[2] The study is under the direction of Lendon Snedeker, M.D.

[3] For a description of both the Premature Series and the Normal Child Series, see Publication No. 1 of the Department of Child Hygiene, Harvard School of Public Health. Reference (9).

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TABLE 1

MENTAL GROWTH OF PREMATURE GIRLS--DEVELOPMENTAL AGE (Months)

Girls under 4 lbs. at Birth		Chronological Age, Reckoned in Months from Birth						
Case No.	Birth Wt. lbs. & ozs.	6 mos.	9 mos.	12 mos.	15 mos.	18 mos.	24 mos.	30 mos.
51	2-4	3.5	--	--	--	--	--	--
58	2-5	--	7.2	10.7	12.5	15.9	21.0	--
73	2-5	3.2	6.9	--	--	15.1	--	--
52	2-6	4.2	7.6	10.7	12.5	14.3	24.0	--
89	2-8	5.2	7.5	10.4	--	--	--	--
90	2-11	4.1	--	9.3	--	--	--	--
23	2-15	--	--	14.3	18.7	23.9	26.3	--
87	2-15½	3.7	--	--	--	--	--	--
71	2-15½	4.2	8.0	10.7	--	--	--	--
62	3-1½	5.5	9.5	12.9	--	18.7	--	--
1500 grams								
68A	3-6	4.2	8.1	12.7	--	16.8	--	--
67	3-6½	--	10.5	--	--	21.7	--	--
206	3-11½	7.0	unsat.	11.4	--	21.7	29.4	--
82A	3-12	--	9.1	13.2	15.1	--	--	--
16	3-13	--	--	--	--	12.9	16.7	--
79	3-15	4.3	7.5	9.2	10.0	14.8	--	--
95	3-15½	4.5	--	--	--	--	--	--
Total Cases-17		12	10	11	5	10	5	
Median	2-15½	4.2	7.8	10.7	12.5	16.4	24.0	
Retardation in mos.		1.8	1.2	1.3	2.5	1.2	0.0	
Girls over 4 but under 5 lbs. at Birth								
68	4-1	4.6	7.9	12.2	13.0	--	--	--
9.	4-2½	--	--	10.7	13.5	17.9	--	--
71A	4-3½	3.9	7.1	11.0	--	--	--	--
88	4-5	6.7	10.8	14.3	15.1	--	--	--
59	4-5½	5.7	unsat.	10.5	unsat.	unsat.	--	--
2000 grams								
94	4-8	6.4	8.3	--	--	--	--	--
65	4-9	2.9	6.4	9.3	12.2	18.3	--	--
38	4-10	--	--	10.4	10.9	13.7	19.0	--
78A	4-10½	--	8.7	11.8	unsat.	--	--	--
204	4-11	6.1	9.9	14.3	--	22.0	30.0	--
74	4-11	6.2	10.0	13.1	18.4	23.0	--	--
66	4-13	5.5	9.4	14.2	18.8	23.0	--	--
34	4-13½	--	--	13.0	18.0	19.2	24.0	--
10	4-14	--	--	--	--	18.0	23.4	--
232	4-14	5.1	9.1	11.5	--	16.5	23.1	--
233	4-15	5.3	9.0	11.9	--	16.9	22.9	--
19	4-15	--	--	12.0	--	17.2	25.0	--
69	4-15	6.1	--	--	--	--	--	--
48	4-15½	--	11.2	13.7	17.7	21.5	30.0	--
Total Cases-19		12	12	16	9	12	8	
Median.	4-11	5.6	9.1	12.0	15.1	18.6	23.7	
Retardation in mos.		.4	.1	0	.6	.6	.3	
Term Babies		6.6	10.0	13.3	--	19.3	26.0	

TABLE 1 - Continued

Girls under 4 lbs. at Birth

Birth Injury	Toxemia	Resuscitation	Notes
--	--	--	Case not followed after 6 mos.
--	--	--	Stubby fing., paddle-like gest., borderline
--	Pre-ecl. II	--	Distractible
--	Puer. sep.	--	Petulant gestures with hands
--	Pre-ecl. II	--	Nervous, overstimulated by mother
--	--	--	Alert, eager, seems normal
--	--	--	Full term by Mother's calculations
--	--	--	Looks Chinesey
--	--	--	Always seems sleepy
--	--	Suction	Cooperative, responsive
1500 grams			
--	Pre-ecl. II	CO_2	Shy at 18 mos.
--	--	--	Prolonged illness, 12-15 mos.
--	Pre-ecl. II	--	Socially immature at 3 yrs.
--	Pre-ecl. I	--	Interested in test
--	--	--	Seems feeble-minded
Caesarean	Pre-ecl. II	--	Seems definitely retarded
Caesarean	Pre-ecl. I	--	

Girls over 4 but under 5 lbs. at Birth

Birth Injury	Toxemia	Resuscitation	Notes
--	Pre-ecl. II	--	Shy at 18 mos. Twin to 68 A
--	--	CO_2 & tub	
--	Pre-ecl. II	--	Twin to 71
--	--	--	Very alert, possibly full term
Jaundice	--	--	Extreme shyness
2000 grams			
Caesarean	Pre-ecl. II	--	Case not followed after 9 mos.
--	--	--	Seemed feeble-minded till 18 mos.
--	--	--	Definitely retarded
--	Pre-ecl. I	--	Extremely shy
--	Pre-ecl. II	--	Excellent cooperation
--	Pre-ecl. II	Suction, Tubbing & CO_2	Advanced in speech
--	--	--	Alert, eager child
--	--	Suction, Tubbing & CO_2	Seems brighter than score
--	Pre-ecl. I	--	Responsive
--	Ppart. ecl.	Suction, Tubbing & CO_2	Identical twins
--	Ppart. ecl.	Suction, Tubbing & CO_2	" "
--	Pre-ecl. II	--	Only partial cooperation
--	--	--	Case not followed after 6 mos.
--	--	--	Alert though shy

Note: For Key to abbreviations see Table 2.

TABLE 2

MENTAL GROWTH OF PREMATURE BOYS--DEVELOPMENTAL AGE (Months)

Boys under 4 lbs. at Birth		Chronological Age, Reckoned in Months from Birth						
Case No.	Birth Wt. lbs. & ozs.	6 mos.	9 mos.	12 mos.	15 mos.	18 mos.	24 mos.	30 mos.
84	2-1	3.9	7.8	9.7	14.3	20.0	--	--
215	2-4½	4.6	8.8	10.2	--	14.7	22.2	32.7
1500 grams								
191	3-6	4.9	8.5	12.1	--	17.2	21.8	--
75	3-8	4.1	--	11.6	15.5	19.9	--	--
80	3-9	4.6	--	--	--	--	--	--
85	3-10	2.8	2.8	8.7	8.3	--	--	--
91	3-14	8.3	--	15.4	--	--	--	--
228	3-15	6.7	9.6	11.2	--	16.0	21.8	--
53	3-15	6.3	10.1	--	--	--	--	--
Total cases-9		9	6	7	3	5	3	1 34
Median	3-9	4.6	8.6	11.2	14.3	17.2	21.8	
Retardation in mos.		1.4	.4	.8	.7	.8	2.2	
Boys over 4 but under 5 lbs. at Birth								
81	4-1½	5.5	9.1	11.4	15.9	--	--	--
17	4-2	--	--	--	--	13.1	17.5	--
50	4-3	4.6	--	10.8	13.0	17.7	21.0	--
61	4-5	5.2	8.9	12.6	14.9	17.7	--	--
46	4-5	5.5	--	12.0	--	--	--	--
60	4-6	4.3	8.7	12.0	14.7	16.1	--	--
2000 grams								
92	4-7½	6.5	8.8	11.9	--	--	--	--
86	4-9	4.4	10.6	11.4	17.9	--	--	--
83	4-11	4.7	7.8	10.7	14.9	--	--	--
77	4-11	8.0	10.1	14.2	16.0	20.0	--	--
2	4-11	--	--	--	16.7	20.6	30.0	--
76	4-12	6.0	9.2	11.7	15.9	18.6	--	--
8	4-12½	--	--	10.4	10.1	17.9	24.0	29.0
56	4-13½	5.2	--	11.8	14.6	17.8	24.0	--
25	4-14	--	--	9.5	11.6	16.3	19.5	--
57	4-14½	3.6	--	--	--	--	--	--
55	4-15	6.0	10.1	12.4	16.8	22.6	30.0	--
4	4-15	--	--	12.0	--	--	--	--
Total cases-18		13	9	15	13	11	7	1 69
Median	4-11	5.2	9.1	11.9	14.9	17.9	24.0	
Retardation in mos.		.8	.1	.2	.1	.3	3.0	
Term Babies		6.7	9.5	12.9	--	20.2	26.8	

TABLE 2 - Continued

Birth Injury	Toxemia	Resus-citation	Notes
Boys under 4 lbs. at Birth			
Hyperemesis. Left as stillborn. When starting to prepare for morgue, 1 hr. later, found alive.			Gives impression of brightness
--	Toxemia	--	
1500 grams			
--	--	Suction	
--	--	--	No words at eighteen months
--	--	--	Case not followed after 6 mos.
--	--	--	Feeble-minded
--	Pre-ecl. I	--	Very superior, trembled
--	Toxemia	--	
--	Pre-ecl. I	--	

Birth Injury	Toxemia	Resus-citation	Notes
Boys over 4 but under 5 lbs. at Birth			
--	Pre-ecl. I	--	Cooperative
--	--	--	Feeble-minded. Twin of 16
--	--	Suction	Stubborn, refused to talk at test
Caesarean	Pre-ecl. I	--	Mother urges
--	--	--	Eager
--	--	--	Lazy at last test
2000 grams			
--	Pre-ecl. I	--	Looks brighter
--	--	--	Lazy at last test
--	--	--	Lacks zest in test
--	--	--	Alert (colored)
--	Pre-ecl. I	--	Advanced
--	Pre-ecl. II	--	
--	--	Suction	Responsive
Caesarean	--	Tub, CO_2 Suction	Ill between 15 and 18 mos.
--	--	--	Seems retarded
--	--	--	Case not followed after 6 mos.
Cer. edema	--	Tub, CO_2 Suction	Alert, bright
--	--	Suction & CO_2	Looks bright

Key to Abbreviations

Pre-ecl. I:	Either albuminuria or elevated blood pressure during preg.
Pre-ecl. II:	Both albuminuria & elevated blood pressure during preg.
Puer. sep. :	Puerperal sepsis.
Cer. edema :	Cerebral edema.

The test applied to these children, a modification of the Yale Developmental Schedule, was worked out by Cattell (3) for use with the normal series of children under observation at the Center. The chief advantage of this scale over existing infant tests are that postural and locomotor items -- sitting, creeping, standing, and walking -- in which premature babies are particularly slow, do not enter into the developmental score; and that a month by month scoring system has been devised so that developmental ages may be computed. The preliminary scaling of items was made on the basis of the tests given the first hundred babies enrolled at the Center, and tentative norms were thus established. When this scale was applied to the second group of babies in the normal series, they scored somewhat higher, on the average, than the tentative norms. This discrepancy between age in months and developmental score has been corrected as far as possible in the final revision of the scale. The preliminary scale was utilized in testing the premature babies, in order that their scores be directly comparable to those of the babies in the normal series. It is not claimed that the developmental ages as reported are entirely accurate, but it seems likely that they are in error only a few tenths of a month at each age, and hence that they are accurate enough to enable one to judge of the degree of retardation of individual cases.

The developmental ages for all examinations on the 63 children are given in Tables 1 and 2. The sexes are listed separately, and the cases are arranged in order of birth weight, which is given in pounds and ounces in the second column. Sub-groupings have been made for birth weights under and over four pounds. For the benefit of those who are accustomed to thinking of birth weights in terms of grams, heavy rulings are made at the orientation points 1500 and 2000 grams. The lower birth weights are more prevalent among the girls; ten girls of birth weights under 1500 grams, but only two boys of this weight are included in the group. Division of the group at four pounds birth weight furnishes groups of sufficient size for medians to have some significance.

The median developmental ages given at the end of each series of cases indicate that prematures of birth weights under four pounds are retarded by a month or more throughout the eighteen month period. At two years, cases are too few to permit a judgment to be made, but at this age the girls, though smaller and more retarded up to fifteen months, seem to have surpassed the boys and to approximate their birth age in development. The reversal of the sex difference at this age is undoubtedly due to the well known sex difference in language development in favor of the girls; girls talk earlier than boys, and speech comprehension and usage plays an important part in the twenty-four month examination. Median developmental ages for babies of birth weights between four and five pounds show retardation of less than a month at six months and no appreciable discrepancy from the birth ages thereafter. In other words these larger premature babies catch up with their age group within the first nine months of life. Sex differences are negligible through twelve months, and thereafter the girls tend to exceed slightly, which again may be attributed to their superiority in speech development.

If, however, the premature groups are compared with the babies of the normal series, even those of birth weights over four pounds are a month retarded throughout the eighteen month period. There is some evidence, however, that the babies of the normal series represent a better sampling of the population than do the prematures. They include few Italian children, whereas a number are included in the premature group; and the socio-economic status of the parents of children in the normal series is better in general than that of the prematures. Consequently, it is likely that the babies of the normal series are somewhat above the general population in average development, and that, as their scores suggest, they are accelerated about half a month at six months, a month at twelve months and two months at two years; i.e. that their developmental quotients at each age center about 108 instead of about 100.

Item Analysis: The items composing the developmental scale consist largely of visual-manual tests at the age of six months. At ages nine and twelve months an increasing proportion of non-manipulative tests are given; these items in general require the child to "see the point" in a demonstration, or to comprehend simple directions given by the examiner. The baby's ability to use speech, as reported by his mother, begins to play a part in the test at twelve months, and becomes fairly important at eighteen months. The items are grouped roughly under these categories in Table 3, which presents comparative data on the two groups of prematures and the normal series.

At age six months the three groups are definitely differentiated from one another in every manipulative item; the group of larger prematures consistently exceeds the group of smaller prematures, and the normal series exceeds all the prematures in the per cent of cases passing. In the non-manipulative items at this age, the differentiation is less clear-cut; the babies of the normal series excel over the prematures in each item, but larger prematures hold only a very slight lead over the smaller prematures.

At nine months the gaps between the three groups in per cent of cases passing each manipulative item have begun to close. The differences are still in the general direction favoring a greater number of successes among infants of greater birth weights, but the degree of difference is somewhat smaller. The non-manipulative items at nine months show even less clear-cut differentiations among the three groups; in fact, there are a few reversals in direction of the differences. Unfortunately, none of the items can be considered primarily social in nature, but the item "adjust to gesture" which includes tricks such as waving bye-bye, and playing pat-a-cake has a large social element. In this item and that of imitating sounds, the larger prematures are the equals of term babies.

By twelve months the differences between term and larger premature babies has further decreased in most items, but the smaller prematures are still somewhat less successful. Reaction to the pellet is probably the one behavioral item most suitable for diagnosing prematurity at the ages of nine and twelve months. Picking up the pill requires no particular strength, and it has sufficient interest for the child to be attempted at these ages. The pincer grasp, however, cannot be executed until neuro-motor development has progressed to a stage that enables the child to divorce his index finger from the other digits, a stage that normally occurs around ten months. Babies that are able to execute pincer prehension at the age of nine months probably are not true prematures, and conversely at twelve months babies that attempt this test with interest but fail it from lack of skill in opposing the thumb and first digit probably are retarded in neuro-muscular development with premature birth as a likely cause.

Manipulating objects in imitation of the examiner or at her command show only slight differentiation among the three groups at twelve months. In speaking vocabularies of one and two words, the three groups are rather clearly separated, but vocabularies of three words or more are accomplishments of about equal frequency for babies of all birth weights. The lead in obedience to the command "No-no" seems to be held by the tiniest babies; this item, as well as that of vocabulary, is obtained from mothers' reports, and it is possible that the mothers of small babies who are not doing quite as well on other test items more often give favorable reports on this. Vocabulary is less subject to the mother's interpretation than the "No-no" reaction, since in the vocabulary test she must name the words the baby uses with meaning.

At eighteen months the three groups are fairly well differentiated on manipulative items, but show no definite trends on items that combine manipu-

TABLE 3

COMPARISON OF DEVELOPMENT IN INDIVIDUAL TEST ITEMS
PER CENT OF CASES PASSING

Manipulative Items - 6 Mos.	Premature Series		Normal S.*
Birth Wt.	Under 4 lb	4-5 lb	Over 5 lb
Recovers rattle from chest	45.5	85.2	98.4
Picks up a cube on contact	50.0	80.8	100.0
Active play with rattle	50.0	77.0	95.9
Rattle, obtains at *shoulder*	30.0	52.0	83.7
Rattle, attains lying	33.3	63.0	88.6
Picks up cube on sight	25.0	50.0	79.0
Cube, holds up two	33.3	51.8	91.1
Lifts cup	31.3	39.3	78.5
Ring, pulls down	31.6	64.4	80.3
Spoon, picks up	26.3	67.8	84.8
Transfer *object*	27.8	51.8	86.8
Paper crumples	15.0	46.4	83.5
Unilateral reaching	13.6	37.1	62.6
Hand preference	9.5	23.1	45.8
Reaching accurate	10.0	19.2	53.4
Cube, picks up deftly	0.0	8.0	37.4
Non-Manipulative Items - 6 Mos.			
Pellet, regard	37.8	38.5	84.1
Pellet, attempts	10.0	11.1	57.7
Mirror, approach	50.0	57.2	79.7
Mirror, pats and smiles	22.7	32.1	49.7
Bell, turn to	42.1	84.6	89.1
Reaching, persistent	26.1	29.6	61.6
Ring, pulls persistently	18.2	23.1	50.6
Ring, inspects with attention	18.2	14.8	48.8

Manipulative Items - 9 Mos.	Premature Series		Normal S.
Birth Wt.	Under 4 lb	4-5 lb	Over 4 lb.
Spoon, bangs	62.5	80.0	96.4
Paper, exploits	66.7	95.0	98.8
Cube, takes two	81.3	89.5	92.8
Hand preference	62.5	88.9	78.9
Ring, pulls by string	56.3	76.3	84.0
Cup, lifts by handle	87.5	84.3	84.0
Pellet, rakes	46.6	66.7	91.6
Pellet, scissors grasp	26.7	33.3	75.2
Pellet, plucks	6.7	19.1	26.8
Drops cube for third	43.8	62.0	52.5
Doll, squeezes	22.2	57.2	50.0
Cube and cup, combines	18.8	47.6	32.2
Spoon, hits cup with	20.0	35.0	34.6
Non-Manipulative Items - 9 Mos.			
String, interest in	73.4	76.3	79.9
Bell, interest in details	50.0	47.6	82.1
Spoon, looks for hidden	66.7	90.0	74.8
Words: "da-da"	56.3	76.3	82.3
Bell, rings in imitation	56.3	52.4	58.5
Adjust to gestures (bye-bye, etc.)	42.8	57.2	75.6
Adjust to words	50.0	66.7	63.3
Imitate sounds	53.4	76.3	65.2
Box and stones, *memory*	0.0	35.7	15.2
Toy, uncovers	35.7	57.1	58.5
Words, one	0.0	23.8	12.3

* Average birth weight for babies of the Normal Series: Boys 7-14, Girls 7-10.

TABLE 3 - Continued

Manipulative Items - 12 Mos.	Premature Series		Normal S.
Birth Wt.	Under 4 lb	4-5 lb	Over 5 lb
Pellet plucks	73.4	67.7	88.8
Pencil, marks	33.3	23.4	67.2
Spoon, rattle in cup	26.9	48.4	58.4
Bottle, poke finger in	23.1	50.0	50.0
Cube, take third	28.6	25.5	40.0
Cube, unwraps	30.8	45.1	29.9
Fits round block into hole	7.1	16.1	29.6
Pellet, bottle, solves	0.0	20.0	12.6
Drops beads in box	0.0	6.9	25.0
Tower of two cubes	0.0	9.7	11.2
Non-Manipulative Items - 12 Mos.			
Doll, hits in imitation	50.0	66.7	68.9
Words, one	33.3	50.0	79.5
Words, two	21.4	45.1	60.0
Words, three	21.4	32.3	39.9
Words, four	21.4	22.6	30.0
Words, five	13.3	6.7	16.8
Obtains cube hidden under cup	73.4	86.7	81.1
Puts cube in cup, one	66.7	80.6	68.2
Puts cube in cup, two	14.3	16.0	22.7
Hits spoons together (imitate)	53.9	65.7	66.3
Cup, take a drink	45.2	50.0	50.0
Obeys "no-no!"	92.4	65.5	80.4
Obtains object behind glass	0.0	18.5	24.3

Manipulative Items - 18 Mos.	Premature Series		Normal S.
Birth Wt.	Under 4 lb	4-5 lb	Over 4 lb.
Pencil, marks	78.6	90.5	10.0
Pencil, scribble	42.9	71.5	70.3
Peg board, 1 peg	78.6	95.3	100.0
Peg board, 2 pegs	71.5	80.0	94.8
Peg board A, completes	42.9	60.0	74.0
Peg board B, completes	28.6	45.0	41.5
Drops beads in box	71.5	94.7	92.6
Puts lid on round box	60.0	92.9	85.9
Fills cup with cubes	64.3	61.9	76.3
Pellet, pours from bottle	71.5	75.0	82.7
Cubes, lower of two	64.3	76.2	87.0
Cubes, lower of three	28.6	38.1	56.3
Cubes, lower of four	28.6	15.8	35.8
Cubes, lower of six	28.6	5.0	
Items Requiring Manipulation & Insight - 18 Mos.			
Form board - round block	85.8	72.7	94.5
Form board - round hole reversed	61.5	60.0	76.6
Form board, square	38.4	47.6	45.4
Form board, solves	28.6	33.3	17.8
Form board, reversed	0.0	9.1	1.8
Obtain toy with stick	33.3	66.7	55.8
Delayed response	46.1	40.0	53.8
Speech - 18 Mos.			
Words, two	78.6	100.0	99.2
Words, three	71.5	81.0	94.1
Words, four	64.3	80.0	89.0
Words, five	64.3	76.2	80.5
Joins two words	14.3	23.8	34.1
Simple sentences	7.7	0.0	10.8
Asks with words	35.7	42.8	65.2
Comprehension - 18 Mos.			
Doll, points to parts	53.8	30.0	63.3
Picture, points to one named	50.0	40.0	63.8
Doll, puts in chair	23.1	42.9	66.0

lative skill with a certain amount of insight or ability to generalize or remember (form-board, delayed response, using stick as a tool). In use of speech the babies of lowest birth weight are poorest and those of the normal series are best. In comprehending and complying to simple directions, however, the smallest babies have no clear handicap.

On the whole the item analysis confirms the findings of other authors that prematurity manifests itself more definitely in motor than in non-motor development. It fails to show that the prematures as a group have any social advantage over term babies by virtue of their having been born into the world of people at an earlier age. Accelerated premature babies, however, do show more acceleration in social than in manipulative items.

Sex Differences: Tabulation of the successes by sex reveals no consistent sex differences on the majority of items at each age, but a few items do show sex differences for the premature babies. At six months there are fourteen items in which boy prematures achieve more successes than girl prematures and no item in which the girls consistently excel. At nine months only eleven items show sex differences, and nine of these favor the boys. At twelve months, however, the trend in sex differences is reversed, the girls exceeding the boys in thirteen of the fourteen items wherein consistent sex differences are shown. At eighteen months sex differences appear in fifteen items, the girls excelling in eight items, and the boys in seven. At twelve and eighteen months girl prematures consistently excel boys in the speech items. Separate tabulations by sexes are not available on the normal series for comparison. It seems probable, however, that the sex differences favoring boy prematures at the ages of six and nine months are largely attributable to the fact that there are fewer boys under three pounds in birth weight. The superiority of the premature girls at twelve months occurs chiefly in language items. It is likely that the condition which obtains at eighteen months, wherein boys excel girls about as often as girls excel boys, represents the truth about sex differences in these items.

Individual Cases: The generalizations made in the foregoing paragraphs are subject to a number of individual exceptions. One is prone to think of the premature baby as developing more rapidly than the term baby and thus gradually over-taking the group of babies of his own birth age. This generalization apparently holds when group results are considered. Individual cases, however, do not bear out this conclusion. Twelve of the 63 premature babies examined, 9 girls and 3 boys, manifested definite acceleration in development during the period under observation; in these cases[4] the acceleration was noted at the nine month examination, and all but one[5] that eventually became accelerated were at least up to birth age in accomplishment by six months. The acceleration in development therefore appears to manifest itself within the first nine months of life. Conversely, premature babies that had not caught up with their age group by nine months remained retarded at least up to two years. There is only one instance of a premature baby (Case 65) showing definite retardation through the fifteen month examination, and suddenly blossoming to normality at eighteen months. The stability of her new rating needs verification by a later examination. In her case, however, it is possible that the sudden improvement is to be explained by the fact that the mother was hard pressed with a family of young children and therefore gave the baby a minimum of attention and stimulation so long as she was contented to lie in her crib. Once the child achieved walking, however, she began to play on the floor with her older brothers, and developed rapidly through contact with them. At least the mother remarked, "Oh, she's getting to be a rogue now;

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[4] Three cases were not tested as early as nine months.

[5] Nancy C. whose six month rating was five and a half months.

she's into everything along with her brothers!"

Only one child of birth weight under three pounds (Case 23) was consistently accelerated, but unfortunately, she was not tested at ages six and nine months. In view of her high scores it is interesting that the mother insisted that according to her calculation the child was full term to a day, although the medical record gives an estimate of seven and a half months gestation. Three other babies who were accelerated (Cases 34, 67, and 88) were thought to be only a week or two premature. Girl 66 is one of the most interesting cases, because she has rather consistently gained ground; her developmental quotients from six to eighteen months are respectively 92, 105, 119, 125, 130. She was estimated as seven weeks premature, and although she had practically caught up with the normal group at six months, she continued to gain throughout the period tested. Paul B., the smallest baby of all, showed remarkable gain between twelve and fifteen months, and he seems likely to equal his birth age by eighteen months.

Of the retarded children at least five seem unquestionably subnormal; these are Numbers 38, 85, 16, 17, and 79. In the case of boy 85, four siblings impress the home visitor as subnormal, so his retardation probably is not attributable entirely to prematurity. The prognoses for Cases 59 and 78A are not very good. These little girls exhibit high irascibility, bursting into tears and actively withdrawing from friendly overtures of the examiner at twelve months. No. 59 in particular held her arms flexed and abducted in the characteristic newborn posture, though she apparently was interested in the toys, and sometimes reached when the examiner pretended not to be looking.

Nervous mannerisms of prematures: A number of peculiar gestures and nervous mannerisms are observable in these premature babies; the examiner is under the impression that the frequency of these gestures is greater than among normal babies. Of the 63 babies examined, 10 had too few examinations for any personality traits or nervous mannerisms to be manifested consistently. For the remaining 53 cases a total of sixty-two nervous mannerisms have been noted. No nervous mannerisms have been reported for 10 of the children, but whether their reactions are entirely wholesome or whether their nervous mannerisms merely excaped the examiner's attention it is impossible to say. This leaves 43 children on whom some notations of tension of one sort or another have been made. For 10 children the notation "extremely alert and responsive" suggests an over-eager, hyperactive reaction to the test situation.

"Shyness" is the most frequent notation; twelve premature babies have manifested a degree of shyness that interfered with the success of the test, at least initially. A sort of dogged determination not to comply to directions has been manifested by ten prematures. This reaction can best be described by quoting excerpts from the notes.[6]

1. "Merle (2 yrs.) either could not or would not talk; her refusal seemed less from shyness than from deliberate determination not to talk."

2. "Nancy (12 mos.) hesitates before taking an object and doing what she is well aware is expected of her. It is as if she really desired to imitate but refrained from it because she did not want to be a copy-cat."

   "Nancy (15 mos.) would start to take a toy then withdraw, apparently not from fear, but often from reluctance to comply with an adult's wishes."

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[6] Each notation was made immediately after the test, and the examiner took scrupulous care not to consult the previous records before making her notes. Consequently, the consistency of the notations from age to age has real significance.

3. "Mary (9 mos.) kicked eagerly with her feet when toys were presented, but held both fists clenched in hard knots, and made no sign with her face or hands that she wanted a toy."

   "Mary (12 and 18 mos.) withdrew arms when toys were offered. When she took one, she would not give it up for another."

4. "Richard (18 mos.) has a slight stubborn streak."

   "Richard (2 yrs.) refused to talk; ignored directions rather than failed to comprehend them."

Peculiar gestures with the hands have been noted for ten babies. Those of Mary have been described above. Paddle-like gestures with the hands have been noted on Veronica, Alice, and Mary. Janice exhibited a petulant grasping reaction, opening and closing her hands rapidly till she got what she wanted. Others slapped, slashed, and banged toys, and Richard, when presented with a toy at fifteen months, "took it and turned it over and over, looking at it from all angles, but his activity was less exploratory than it seemed, for after looking he did nothing else. The turning was merely an idle gesture."

Hypersensitivity to sounds has been noted on six premature babies; footfalls or voices in the corridor distracted them from the test. Robert and Frank continued to show exceptional distraction to sounds at two and a half and three years respectively. Indeed, the noise of a book's being dropped on the floor caused Frank, aged three years, to exclaim, "That's a bomb!"

Nine premature babies have been extremely irascible, bursting into tears at the slightest provocation, as for example, when one toy was taken away, even though another was proffered at the same time. Five have been described as "nervous" or "jittery" babies; some have shuddered or trembled at the tests.

While similar manifestations have also been seen in babies of the normal series, they have not been observed as frequently as among prematures. The paddle-like hand gesture occurred in only one baby of the normal series, and she has proved to be feeble-minded.

Maternal Training of Premature Babies: The high incidence of "nervous" behavior in premature babies suggests either that they inherit less stable nervous systems than do babies born at term, or that exposure to external stimulation at a time when they normally would be enjoying the tranquility of intrauterine environment is hard on underdeveloped nervous systems. Possibly the environmental milieu of the premature is entirely responsible for their development of nervous mannerisms. The staff members who come in contact with the mothers of these babies are under the impression that they are considerably more anxious than mothers of babies in the normal series. Mothers of prematures hover over the infant with great solicitude, and they go to extremes of over- or under-stimulation in his care. The mothers recognize the baby's precarious condition, and at first are over-zealous in sheltering him from stimulation, perhaps protecting him more than need be. As the baby grows and approaches the normality in size and development, mothers often grow eager for him to close the gap entirely, and they over-urge the child; they are particularly likely to do this when the baby's intellectual grasp exceeds his manipulative ability. At least five of the mothers have interfered in the testing situation by over-urging the child to attempt things just beyond his level of accomplishment.

The age of the mother, and her experience with or expectancy of other children unquestionably influences her attitude toward the premature. A number of the babies are the first-born children of mothers in the middle thirties or beyond, and in some cases the child is the first viable baby from a series of pregnancies. Such mothers naturally are over-anxious lest they never be able to have another baby should something happen to this one. The mother of one of the prematures died at the baby's birth, leaving the child to be reared by a devoted father, a fussy paternal grandmother and a series of nursemaids. The mothers of the ten babies on whom no nervous mannerisms have been noted are either under thirty, or have other living children.

In their follow-up study of older premature babies Hess, Mohr, and Bartelme (5) discovered an excess of nervous habits in prematures as compared to their term siblings. Apparently, therefore, nervous habits not only are engendered in infancy but also persist and are extremely difficult to break. This is particularly true of thumbsucking and of bladder incontinence. In consideration of the greater hazard in developing nervous behavior it would seem that mothers of prematures need a different type of mental hygiene from that given to mothers of term babies. Probably they should be discouraged from regarding and treating the baby as unusual or exceptional to any greater degree than necessary. They should realize that by allowing the baby to set his own developmental pace they are probably reducing to a minimum the hazard prematurity imposes on normal emotional development. They should be assured that his chances for making up his intellectual discrepancy are good, but they should not be given too much hope for eventual acceleration if he remains "backward" beyond the age of two.

SUMMARY

The results of 215 developmental tests administered to 63 babies of birth weights under five pounds indicate:

1. That babies of birth weights under four pounds are retarded by a month or more through the eighteen month period, whereas babies of birth weights four to five pounds overtake the normal group by nine months of age.
2. That premature babies are more retarded in manipulative development than in intellectual grasp and social responsiveness.
3. That 10 per cent (six cases) of the group showed definite acceleration by the age of nine months; and that an equal number showed such consistent retardation throughout the period of testing as to warrant the prediction of feeble-mindedness.
4. That premature babies manifest more "nervous" mannerisms than babies born at term.
5. That primaparity, advanced age of the mother, and twinning, all of which are more common conditions among prematures than among normal babies, predetermine for the premature a somewhat unusual environment that may foster the development of nervous habits.

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A SUPERIOR CHILD WHO WOULD NOT TALK

MELVIN G. RIGG[1]

Size of vocabulary has been regarded as the best single indication of intelligence. The failure of a child to develop normally in this respect would consequently appear to be a very bad sign. Occasionally, however, we find a child who breaks all the rules, and Carolyn is a case in point.

At the age of two Carolyn could say only thirteen words, as follows: bread; butter; bye; daddy; gak (milk); here; is; it; mother; there; wow-wow; Gaga (Arthur); Gak (Jack).

The writer has made little attempt to indicate how these words actually sounded. The child's pronunciation was extremely "dutchy," and the parents often despaired of being able to reduce it to exact phonetic symbols. The pronunciation did not improve greatly until she started to school at the age of six, when, under the direction of an excellent primary teacher, rapid progress was made.

Whether this faulty pronunciation was connected with the abnormally slow vocabulary development is an interesting question. No other explanation suggests itself. Carolyn is the daughter of a college professor. The mother was before her marriage also a college professor. Carolyn has a brother two years older, and has always played with other children. The home in no way presents an environment which is unusual.

The full extent of Carolyn's vocabulary deficiency can be appreciated only by a comparison with the accomplishments of other two-year-olds. After a search of the literature, the writer has found a total of thirty-three cases of two-year-old children for whom vocabulary counts have been made. These vocabularies range from 5 to 1400 words. The mean is 520 and the mid score is 507. Among these thirty-three cases, Carolyn ranks next to the lowest.

These thirty-three counts represent attempts to list the actual words in each child's vocabulary. It is true that the different totals are not directly comparable, since each investigator formulated his own rules as to what should constitute a separate word. But this consideration can scarcely cover up a discrepancy between 13 and 520 words! It is also true that most of these children are very superior in intelligence, sons and daughters of college professors, and living in homes that are above average from the intellectual point of view. But since Carolyn belongs in this class herself, the point furnishes no excuse for her poor showing.

Smith,[2] in attempting to estimate the total vocabularies of twenty-five two-year-olds by means of a vocabulary test, found a mean of 272 words. These children are presumably less brilliant than most of those for whom total counts have been made, although they were considered somewhat above average. But their vocabulary development is still far above that of Carolyn.

During her third year Carolyn made rapid progress, and at the age of three had a spoken vocabulary of 652 words. However, for nineteen published vocabulary counts of three-year-old children, the mean is 1230 and the mid score, 1139. The range is 48 to 2282.[3] Smith,[4] using a vocabulary test,

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[1] From Oklahoma Agricultural and Mechanical College, School of Education, Stillwater, Oklahoma.

[2] Smith, M. E., An Investigation of the Development of the Sentence and the Extent of Vocabulary in Young Children, University of Iowa Studies in Child Welfare, v. 3, No. 5, pp. 92.

[3] The case showing only 48 words at age three is the same as the one showing 5 words at age two. This child had 1135 words at age four. Nice, M. M., A Child Who Would Not Talk, Ped. Sem., v. 32, 1925, pp. 105-142.

[4] op. cit.

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estimated the average vocabulary of 20 three-year-olds to be 806 words. Drever[5] reports four slum children as averaging 376 words. Carolyn is superior to these slum children, but is inferior to Smith's cases and far behind most of the cases for whom total vocabulary counts have been made.

Even at the age of three, however, Carolyn gave evidence of intellectual superiority. She was given the Stanford-Binet test (1916 form) and earned an I.Q. of 133, passing all of the three-year tests, four tests at year four, and two tests at year five.

At the age of four, Carolyn had a spoken vocabulary of 1019 words. Twelve published vocabulary counts at this age have a mean of 2002 words, a mid score of 1010, and a range from 1019 to 4200, Carolyn's total being the lowest. Smith's[6] 26 four-year-olds were estimated to have an average vocabulary of 1540 words. Their average I.Q. was 109. Drever[7] reports five four-year-old slum children to average 451 words. Carolyn's vocabulary development is still relatively poor, especially in view of her intelligence rating.

No further vocabulary counts were made for Carolyn. She started to school at the age of six. The next spring, at the age of six years ten months, she was again given the Stanford-Binet test (1916 form). She passed all the tests at year eight, four tests at year nine, two tests at year ten, and two at year twelve, making an I.Q. of 139. She knew 20 words in the vocabulary, the norm for year eight. This fact indicates that her early vocabulary deficiency had by this time been made up. Some two months later, she was retested by a clinician at the Ohio State University, and earned an I.Q. of 137. As a result of superior work in Grade One, she was given a double promotion to Grade Three. She adjusted herself to this change and has continued to earn very satisfactory marks.

At the age of eight years ten months, Carolyn was again given the Stanford-Binet test (1937 revision). Her I.Q. was 147. This gain was of course to be expected, since the 1937 revision gives higher ratings to superior children. At this time she knew 20 words of the revised vocabulary, the norm for average adults! Her vocabulary development is now indicated as definitely superior.

In the opinion of the writer, two important deductions can be made from this case. First, even an extreme deficiency of vocabulary development at two years of age does not necessarily indicate deficiency of intelligence. Second, it does not even indicate a relative vocabulary deficiency in later years.

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[5] Drever, J. The Vocabulary of a Free Kindergarten Child, J. Experimental Pedagogy, v. 5, 1919, pp. 28-37.

[6] op. cit.

[7] op. cit.

THE INTERNATIONAL KINDERGARTEN UNION WORD LIST COMPARED WITH EIGHT SPOKEN VOCABULARIES

MELVIN G. RIGG[1]

The Child Study Committee of the International Kindergarten Union (I.K.U.) has published a "Vocabulary of Children Before Entering the First Grade."[2] This "Kindergarten List" was based upon a study of 489,556 running words, of which 7,106 were different words. The list is composed of the 2,596 words which occurred seven times or more. In making this list each inflection was counted separately. However, words used as different parts of speech or in different meanings were counted only once.

The present writer has thought that it would be interesting to compare this I.K.U. list with spoken vocabularies of individual children. The eight vocabularies involved in the present study were collected from five different children at ages from two to four. In each case the attempt was made to list the child's complete vocabulary. No recording devices were available, but the child's mother made a careful record of all the different words used. This record was begun in each case four weeks before the birthday, and lasted for two weeks afterward. It is of course probable that some words were missed. To be included, the word had to be employed meaningfully by the child; words repeated parrot-like or used only in songs or nursery rhymes were not listed. It was quite allowable, however, to ask the child to name objects, and the mothers were encouraged to do this. Rules were formulated for the handling of grammatical variants. The first use of a word in any form was included in the main list. Each additional variant which was regularly formed was listed in a grammatical variant list. Irregular forms were, however, considered in all cases to be separate words, and were included in the main list. Proper names were listed separately. These vocabularies were summarized in Table 1.

TABLE 1

A SUMMARY OF EIGHT TOTAL VOCABULARY COUNTS

Name	I.Q.	Age	Main list	Grammatical Variants	Proper Names	Total
Cynthia		2	368	10	22	400
Carolyn	133 139 137 147	2 3 4	11 643 938	0 2 3	2 7 78	13 652 1019
Pernetta	139	3	1034	23	49	1106
Charles	122	3	533	18	17	568
Edward	117 129	3 4	898 1392	15 19	12 158	925 1569

These I.Q.'s were all based on the 1916 Stanford-Binet, except the one of 147 for Carolyn, which was based on the 1937 Stanford-Binet. The gain in this rating was to be expected, since superior children are supposed to score higher on the 1937 revision. These tests were not given simultaneously with the collecting of the vocabularies; in some cases the tests were administered

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[1] From Oklahoma Agricultural and Mechanical College, School of Education, Stillwater, Oklahoma.

[2] The International Kindergarten Union, 1201 Sixteenth St., N. W., Washington, D. C.

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TABLE 1

DISTRIBUTION OF STANFORD ACHIEVEMENT TEST READING SCORES

Grade Score																					
10.0+				1	5	9	15			4	13	20	25	21		1	4	19	20	18	8
10.0						3	1			1	1	2	3				4	3	2	1	
8										3		3	1	1		1		3			
6					2		3			2	1	2	1	1			2		2		
4				1	2	2	1			1	2	2					1	2	2		
2				1	1	2				1	3	3				2	3	1	2		
9.0					1	4					1	1					1	1	1		
8					1						3	1					2	2	1		
6					2					1		1	1				2				
4				1	1		1			4	2	1									
2				1	2					2	1						1				
8.0				3						1	3						2	1			
8			1	3	2	2			1	4							2				
6				1	1	1			1		1						2				
4			2	1	3					1	2					1	2	1			
2			1	1	1	1				2	1										
7.0				3	2	1				4	2										
8			1	2		1											1	1			
6			2	4	2					2	1					1	1				
4				2					1	2	1						1				
2			4		1	1			1	1	2					3					
6.0			1	2	1					3						4					
8			4	4					3	2	1					2					
6			5	4					4	3					3						
4		2	3	2	1				5	1					1	1					
2		1	3	2				1	5	1					2	5	1				
5.0			4					2	4	1						3					
8			2	2		1		2	3	2					2	2					
6		2	3	2					3	1					1	2	1	1			
4	1	5	1	1				3	5						3	1					
2		4	3					4	4						1	2					
4.0	1	8	1		1			5	3						2	1					
8		5	2					1	4								1				
6		2	2					2							2						
4	2	3	2					2	1												
2	1	4	1	1				2	1						1						
3.0	5	2						5								1					
8	10	7						4	1						2						
6	4	1						2													
4	14	1						2							2	1					
2																					
2.0																					
Grade	2	3	4	5	6	7	8	2	3	4	5	6	7	8	2	3	4	5	6	7	8
N	38	47	48	45	32	28	22	37	50	53	41	36	31	23	22	34	34	33	30	19	8
Median	2.6	3.9	5.4	6.6	8.3	9.4	10.0+	3.8	5.0	7.4	9.1	10.0+	10.0+	10.0+	4.5	5.4	8.8	10.0+	10.0+	10.0+	10.0+
Groups	A							G-1							G-2						

reading scores, next largest in spelling and smallest in arithmetic. Slight inconsistencies which appear in several of the higher grade levels may be attributed to the smaller numbers of cases involved. The gifted group G2 shows the most rapid acceleration toward maturity in the achievement measured by the test, the average group the least rapid acceleration. The gifted group G2 quickly reaches a point in the reading tests where the test is no longer adequate as a measuring instrument. This point is not so quickly reached by this group in arithmetic and spelling as in reading, but is more quickly reached by group G2 than by G1, and much more rapidly than the average group. A child who attains a grade score of 10.0+ is no longer adequately measured by the test. Since group G2 was the youngest at the time of the annual test and Group A the oldest (see Table 4), the results are even more favorable to Group G2.

TABLE 2

DISTRIBUTION OF STANFORD ACHIEVEMENT TEST ARITHMETIC SCORES

Grade Score																					
10.0+					1	2	3					12	13	14			1	4	18	9	6
10.0							2				1	1	2								
8							1					1	3	2							
6														1				2		1	
4											1		1					2		2	1
2						1	1				1	1	1	1				3	1	1	1
9.0					1						1	2	1						2		
8					2		3					1	1					1		2	
6							2					2						1			
4					2	1	1				3	4	1	1				2	2	3	
2						1						1	1						1	1	
8.0											2	1	1				2	1	2		
8					1	2					3	3	1					1		1	
6					3	3	2				4	1						2	1		
4					3	1					5		2				1	1	1		
2					2	2	1				2	1									
7.0					1	2	2				5	1						3	1		
8					1	2							1	1				1			
6				1	2	4	1			2	3	3									
4				1	3	1				1	1						1	3			
2				2	1		1			3	1						2	4			
6.0				3	2	3	1			3	1						2				
8			1	4	3	1				4	2	1				1	6				
6			1	7	2	1			1	8	1					1	3				
4				4	2	1			2	3	1					1	5	2			
2			1	6					1	8	3					5	3				
5.0			4	3	1				3	4							1				
8			9	6					8	5						1					
6		1	5	2					4	3						3	2				
4		1	3	2		1			6	4						6	2				
2		3	7						5	1					1	2					
4.0		2	3	1				1	1	1						1	3				
8		2	2	1				3	3						3	1					
6		1	2	1				2	5						1	5					
4	1	3	5					2	4							1					
2		8	1					4	2						2	4					
3.0	7	11	3					8	3						5	1					
8	6	4	1					1	3						4	1					
6	4	7						2	1						4						
4	15	3						4	1						2						
2	5																				
2.0																					
Grade	2	3	4	5	6	7	8	2	3	4	5	6	7	8	2	3	4	5	6	7	8
N	38	47	48	44	33	28	22	39	50	50	41	36	29	20	22	34	34	33	29	20	8
Median	2.5	3.2	4.4	5.4	6.9	7.1	8.7	3.0	4.4	5.4	7.4	8.8	10.0	10.0+	3.04	4.4	5.7	7.9	10.0+	9.6	10.0+
Groups	A							G-1							G-2						

Data for the school as a whole, from year to year, show that grade scores in reading at each grade level are higher than in arithmetic and spelling, especially at grade four and beyond. The difference in acceleration for all groups in the three subjects can be accounted for partly in terms of the subjects themselves, the different psychological processes involved in learning to read or spell as contrasted with learning arithmetic; and also in the way in which and time at which elementary instruction in these skills is given at the school. There is a tendency to begin systematic instruction earlier in reading than in spelling or arithmetic. Furthermore, the transfer effect from reading to spelling is naturally somewhat greater in the early years than spread of training from reading to arithmetic.

The child who is well started in reading techniques by the end of the second or third grade can make progress quite independently from that point

TABLE 3

DISTRIBUTION OF STANFORD ACHIEVEMENT TEST SPELLING SCORES

Grade Score																					
10.0+												2	12	12				1	7	9	5
							3														
10.0						1	2						1								
8						1						2	1								
6						1						4							1	1	
4												1	1	1						1	1
2				1		2	3					2	1					1		3	
9.0						2					2	1	1					2	1		
8					1							1	2					1	2		
6						1	1				2		1					1	1		
4					3		4				1	3	1	1				1	5		1
2						1	1				1	1	2						4	2	
8.0						4					1		1	2			1	2	2	1	
8						2					3	2	1	1				1	1		
6			1		1	3	1			3	1	1				2	3	3	3		
4					2	2				1	2	5	1					3			
2							1				3	1					4	2			1
7.0				1	1		3			3	3	3	2				2	3			
8				2	4	1	1		1	1	1						2	2		1	
6				1	3	2			1	3	4	6					1				
4					1				1	2	4	1					3				
2				5	4	1	1			2							3	3	1	1	
6.0				3	2	1			1	1	2	1				6			1		
8			1	2	1				1	1	1							1			
6			3	1	3	1			1	4	2	1					5	1			
4		1		4	1	1		1	6	6	2					2	7	1			
2			3	4	1				2	3	1					2					
5.0		1	5	4	2				1	4					1	1		1	1		
8	1	1	3	5		1			3	4	1				3	4	2	1			
6		1	8	6				1	8	2	2				1	3	2	1			
4		2	4	1						3						2					
2		2	1					1	1	2					2	1					
4.0	1	3	1	2	1				3		1				2	3	3				
8		2	3	1				2	4						2	3					
6	1	5	7	1	1			2	4	1					1						
4	2	2	3					3	2	2							1				
2	1	9	3	1				7	5							1					
3.0	3	4	1					8	2	1					2	2					
8	5	8						6	2						3	1					
6	6	4						1	1	1					2	1					
4	18	2						7							3						
2																					
2.0																					
Grade	2	3	4	5	6	7	8	2	3	4	5	6	7	8	2	3	4	5	6	7	8
N	38	47	47	45	32	28	21	39	50	50	40	38	28	17	22	34	34	32	29	19	8
Median	2.6	3.1	4.6	5.3	6.4	7.9	8.5	3.1	4.6	5.5	6.8	7.8	9.7	10.0+	3.8	4.8	6.3	7.4	8.5	9.7	10.0+
Groups	A							G-1							G-2						

on provided that he is normally stimulated to read by his experiences and has readily available an adequate and appropriate supply of reading material. In spelling and arithmetic, however, somewhat more direct teaching and carefully supervised exposure to new words and algorisms is necessary in order to keep the learning curve steadily accelerating during the elementary school years. The child is less apt to continue learning to spell increasingly difficult words on his own initiative, because the process is a mechanical one, has no content, and therefore lacks meaning in itself. In arithmetic, even more than in spelling, the newer, more intricate and complex processes can only be gained by

TABLE 4

DISTRIBUTIONS OF CHRONOLOGICAL AGE AND STANFORD BINET INTELLIGENCE QUOTIENTS

Chronological Age									
10-0									
10	1			IQ		IQ		IQ	
8	1								
6	3			110		139	3	161	2
4	3	2		109	1	138	5	160	1
2	12		1	108	7	137	6	159	1
9-0	6	4	3	107	4	136	2	158	
10	5	4		106	5	135	3	157	
8	8	5	2	105	2	134	5	156	3
6	1	7	7	104	5	133	5	155	2
4	2	8	5	103	6	132	9	154	2
2	6	5	7	102	3	131	2	153	1
8-0	2	5	4	101	2	130	11	152	
10		6	3	100	5			151	
8		4	2	99				150	1
6		1	1	98	2			149	1
4			1	97	3			148	1
2				96	1			147	2
7-0				95	1			146	3
10				94	3			145	2
8				93				144	2
6				92				143	1
4				91				142	3
2				90				141	4
6-0								140	4
N	50	51	36	N	50		51		36
Median	9-0	8-5	8-4	Median	103.8		133.7		146.7
Groups	A	G-1	G-2		A		G-1		G-2

most children through direct instruction. The amount of instruction necessarily varies with the age and ability of the child, but few children acquire through their own unguided efforts sufficient skill in arithmetic to keep the learning curve smoothly and positively accelerated during the elementary school years. This holds true more particularly of computation than of written problems involving fairly simple computation, since reasoning of this sort is akin to the reading process itself.

Children in these three groups were not segregated for classroom instruction but worked together under substantially the same conditions at all times. These records afford an excellent opportunity to observe the differentiation in learning which takes place in spite of fairly uniform instruction for all the children regardless of ability. The rapid acceleration shown by the brighter children took place without any special school provisions for their needs as contrasted with the slower children. There was no differentiation in content work, opportunity to use the library, and other conditions except as the children themselves imposed them. As differences appeared, small groups of the less capable children within the larger heterogeneous class were given work in skills more suited to their needs than that provided for the faster learners. Almost invariably as the upper grades were reached the children in Group A were found to be in need of "remedial work" or special individualized help for a longer or shorter period of time. This help was given by classroom teachers, teaching assistants, or by specially employed tutors. Sometimes one of these slower learning children received help in all three skills; in most cases in not more than one or two. More children received help in reading than in the other subjects. Children in the gifted groups received no such help, at least

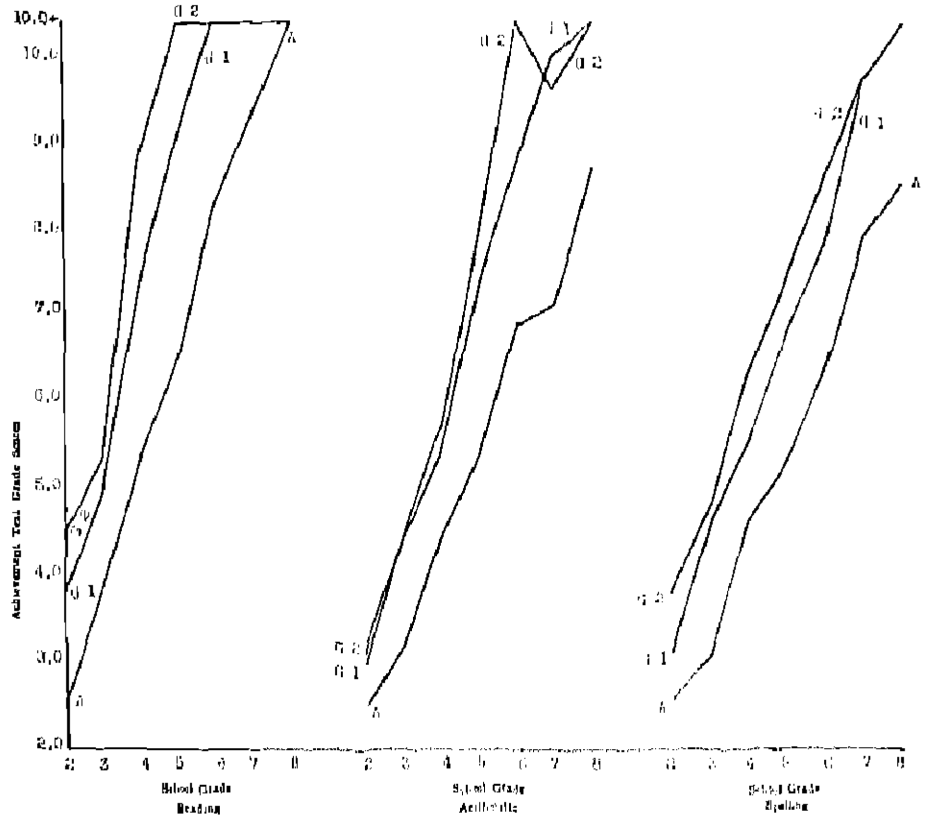

Figure 1. Stanford Achievement Test Median Curves for Three Ability Groups

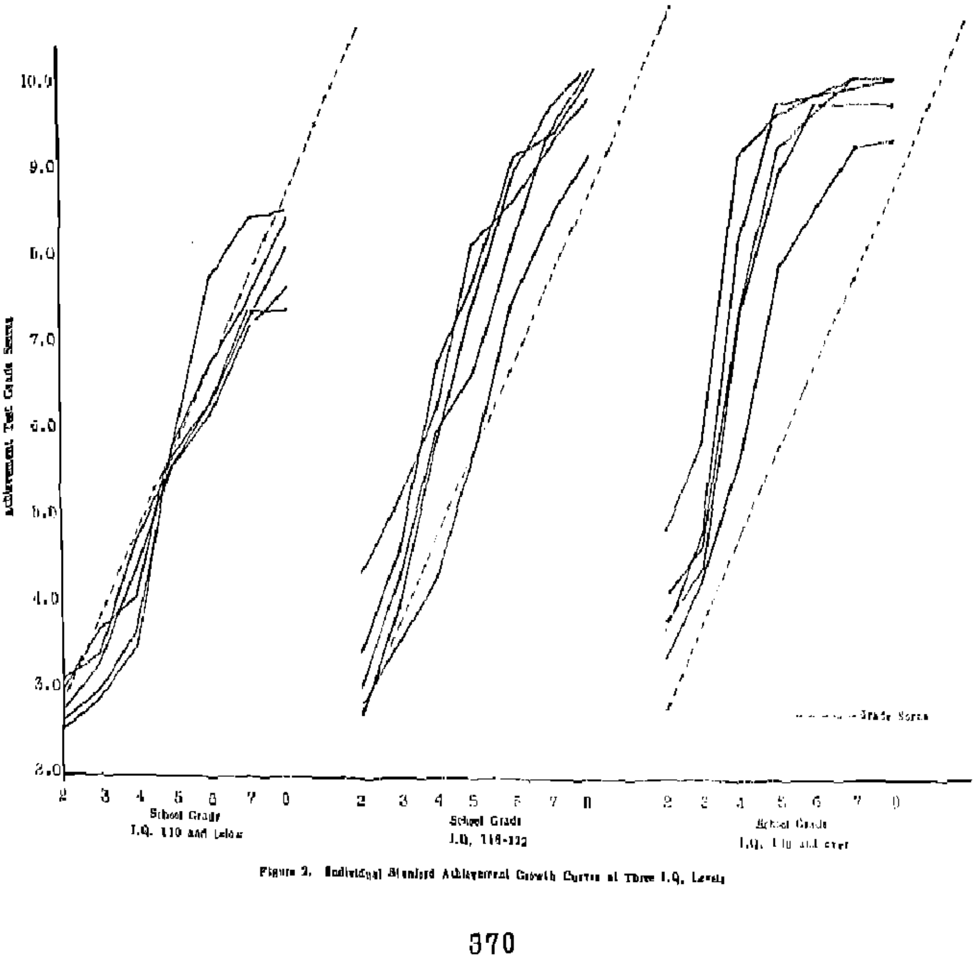

Figure 2. Individual Stanford Achievement Growth Curves at Three I.Q. Levels

on the part of the school.

That achievement in academic school work through the elementary grades is in itself a test of intelligence when learning conditions are similar for a given population has been recognized since long before the advent of intelligence tests. Learning to read and the matured process of reading requires constant exercise of reasoning and judgment. To guess correctly and infer quickly from content what meaning shall logically follow is the chief essential in rapid and accurate reading. Learning to spell taxes the memory, requires skill in making perceptual discriminations and in forming associations. The mental gymnastics required to hurdle fractions, the difficulties in learning long division or even the multiplication tables have been recognized ever since the first discouraged school child "failed" in arithmetic. When environmental conditions for learning are fairly uniform as they were in the case of the present study, it may be assumed that the differences found may in part be attributed to the child's individual ability to learn and to profit from instruction.

Within the separate groups themselves wide individual differences in learning are found. There is marked overlapping between the distributions of scores in the separate subjects in the two gifted groups; there is also considerable overlapping in the gifted and average groups. These overlappings in part are attributable to variations in chronological age and mental ability among the individuals within any one group. In these groups as in most school classes this variation is found to be two years or more. Furthermore, personality and behavior characteristics, individual social and emotional traits affect learning as all teachers know. This is particularly true of children during the initial stages in learning to master any skill; the child's subsequent progress is also affected by his initial success in achievement. In view of these facts, we cannot expect the correlation between potential scholastic aptitude and eventual achievement to be perfect. In view of the many factors that influence and at times distort the learning curve, the general consistency in the trends observed in this study are all the more significant.

These median curves for the three groups suggest the futility of trying to bring the comparatively slower learner up to the level of more gifted children through special remedial drill. The time thus spent in many schools could be spent in more profitable ways so far as the pupils are concerned. Instead of disregarding or discrediting data that reveal differences in learning potentiality, educators should welcome the saving in time and energy that consideration for these facts in educational programs generally would entail. The data summarized in this study suggest the need and economy of individualizing work in the skill subjects within classroom groups.

That the slower learners tend not to survive in the school as well as the gifted children is shown by the numbers of cases available for study. In the two gifted groups combined there were 86 cases with a succession of three or more annual Stanford tests; and there were 51 such cases in the slower group. Yet the pupil intake in the school during the period covered by these data is in the ratio of approximately 50:50 for the two groups. If anything, the Stanford data summarized here represent a natural selection among the slower learners - those cases that do not drop out as soon as difficulties in learning appear.

HOUR OF BIRTH AND STILLBIRTH AND NEONATAL MORTALITY RATES

J. YERUSHALMY[1]

It is well known that births do not occur uniformly throughout the day. There are, proportionately, more births between midnight and noon than between noon and midnight. DePorte (1) showed that the distribution of stillbirths in 1929 in New York State, exclusive of New York City, was, in general, opposite to that of live births, and that the stillbirth rate per 1000 total births varied considerably with the hour of birth. Infants born in the afternoon were exposed to a greater risk of being born dead than those born in the morning. The highest stillbirth rate was found for infants born between 3 and 6 P.M. Comments by several leading obstetricians on these rereported findings are included in DePorte's paper. These comments suggest two possible explanations: (a) that "during the afternoon there are a larger number of cases which are delivered after a long labor, as labor usually begins during the previous night or early morning," and (b) that "during the later afternoon hours there may be more operative interference and a greater use of pituitrin because of the fact that most physicians are particularly busy at this time, either at their offices or in making rounds of their different patients. In the early morning hours, on the other hand, they are perhaps slower to terminate any given case owing to the courage it takes to get out of bed at such time." One observer[2] suggested that "if it is possible to do so, you check the incidence of operative deliveries during the different time periods which you have analyzed. You might find that the incidence of operative deliveries would be higher at certain times of day than during the other periods."

It is appreciated that neither of these suggestions can be tested fully with the material available in a health department. It is also realized that even if the incidence of operative deliveries by hour of birth follows the same pattern as the stillbirth rate it does not follow that there is a causal relationship between them. It was thought worth while, nevertheless, to study the stillbirth rate by hour of birth in New York State, exclusive of New York City, for the births of another year (1936), and to add the same information for neonatal mortality (death of infants under one month of age) and for incidence of operative deliveries.

Table 1 shows the percentage distribution of live births by hour of birth in three-hour periods for New York State, exclusive of New York City, for the years 1929 (DePorte's figures) and for 1936, and in addition figures from a table given by Bradford Hill (2). This last table does not specify the place and year of birth, but it presumably refers to some unspecified locality in England.

It may be observed that the variations in the percentages by hour of birth are very similar in the three columns. The births in each case were more numerous between the hours of midnight and noon than between noon and midnight. The respective percentages for the morning births were 55.0 in 1929, 54.1 in 1936, and 54.4 for Bradford Hill's figures.

The distribution of the stillbirths by hour of birth in the same places is shown in Table 2.

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[1] From Division of Maternity, Infancy, and Child Hygiene, New York State Department of Health. The author wishes to express his appreciation to Dr. Archibald S. Dean, District State Health Director for the Buffalo District, and to Mr. Thomas J. Duffield, Registrar of Records for the New York City Department of Health, for furnishing the tables on operative procedure by hour of birth.

[2] Dr. Fred L. Adair, University of Chicago.

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TABLE 1

DISTRIBUTION OF LIVE BIRTHS BY HOUR OF BIRTH, NEW YORK STATE, EXCLUSIVE OF NEW YORK CITY, 1929 AND 1936, AND FIGURES FROM BRADFORD HILL

Hour of Birth	Number of Births			Per Cent		
	1929	1936	Figures from Bradford Hill	1929	1936	Figures from Bradford Hill
Total	92,662	82,077	32,224	100.0	100.0	100.0
12 to 2 A.M.	11,990	10,706	4,064	12.9	13.0	12.6
3 to 5 "	13,289	11,360	4,627	14.3	13.8	14.4
6 to 8 "	12,699	10,933	4,488	13.7	13.3	13.9
9 to 11 "	13,011	11,379	4,351	14.0	13.9	13.5
12 to 2 P.M.	9,604	9,010	3,262	10.4	11.0	10.1
3 to 5 "	10,232	9,496	3,670	11.0	11.6	11.3
6 to 8 "	9,910	8,965	3,577	10.7	10.9	11.1
9 to 11 "	11,927	10,228	4,225	12.9	12.5	13.1

TABLE 2

DISTRIBUTION OF STILLBIRTHS BY HOUR OF BIRTH, NEW YORK STATE, EXCLUSIVE OF NEW YORK CITY, 1929 AND 1936, AND FIGURES GIVEN BY BRADFORD HILL

Hour of Birth	Number of Stillbirths			Per Cent		
	1929	1936	Figures from Bradford Hill	1929	1936	Figures from Bradford Hill
Total	3,345	2,288	1,272	100.0	100.0	100.0
12 - 2 A.M.	409	300	126	12.2	13.1	9.9
3 - 5 "	415	261	157	12.4	11.4	12.3
6 - 8 "	370	283	142	11.1	12.4	11.2
9 - 11 "	442	304	195	13.2	13.3	15.3
12 - 2 P.M.	366	263	150	10.9	11.5	11.8
3 - 5 "	474	317	178	14.2	13.9	14.0
6 - 8 "	418	270	144	12.5	11.8	11.3
9 - 11 "	451	290	180	13.5	12.7	14.2

The distribution of stillbirths was quite distinct from that of live births for each set of data. Whereas the live births were generally more numerous in the morning, there were somewhat more stillbirths in the afternoon. The respective percentages for the morning stillbirths were 48.9 in 1929, 50.2 in 1936, and 48.7 for Bradford Hill's figures.

Tables 1 and 2 are combined in Table 3 to give the stillbirth rates per 1000 total births by hour of birth.

The general trend is the same in all three cases. The stillbirth rate was considerably higher in the afternoon than in the morning. The respective rates for the births between midnight and noon were 31.1 in 1929, 25.2 in 1936, and 34.2 for Bradford Hill's figures. The corresponding rates for the births between noon and midnight were 39.4, 29.4, and 42.6. The corresponding percentage increases in the stillbirth rates for the afternoon over the morning births were 27, 17, and 24. The highest stillbirth rate for each set of data was recorded for the infants born between 3 and 6 P.M.

For purposes of another study (3), the birth certificates for all the neonatal deaths in 1936 in New York State, exclusive of New York City, were located. It was therefore possible to tabulate these deaths by hour of birth. The neonatal mortality rate by hour of birth followed on the whole the same trend as the stillbirth rate. Also in this case the mortality rate in the afternoon hours was considerably above that in the morning hours and the neonatal mortality rate was highest also between 3 and 6 P.M. Since there are undoubtedly some stillbirths which should have been registered as neonatal deaths

TABLE 3

STILLBIRTH RATES PER 1000 TOTAL BIRTHS BY HOUR OF BIRTH, NEW YORK STATE, EXCLUSIVE OF NEW YORK CITY, 1929 AND 1936, AND FIGURES FROM BRADFORD HILL

Hour of Birth	Stillbirth Rates*		
	1929	1936	Figures from Bradford Hill
Total	34.8	27.1	38.0
12 - 2 A.M.	33.0	27.3	30.1
3 - 5 "	30.3	22.5	32.8
6 - 8 "	28.3	25.2	30.7
9 - 11 "	32.9	26.0	42.9
12 - 2 P.M.	36.7	28.4	44.0
3 - 5 "	44.3	32.3	46.7
6 - 8 "	40.5	29.2	38.7
9 - 11 "	36.4	27.6	40.9

*Per 1000 total births (including stillbirths)

and conversely some neonatal deaths which are actually stillbirths, it is probably best to inspect the combined loss, i.e., the number of stillbirths and neonatal deaths per 1000 total births. The neonatal mortality rates and the rates for combined loss by hour of birth are presented in Table 4.

TABLE 4

NEONATAL MORTALITY AND COMBINED LOSS (LATE FETAL AND NEONATAL MORTALITY) BY HOUR OF BIRTH. NEW YORK STATE, EXCLUSIVE OF NEW YORK CITY, 1936

Hour of Birth	Numbers		Rates	
	Neonatal Deaths	Combined Loss	Neonatal* Mortality	Combined** Loss
12 - 2 A.M.	293	593	27.4	53.9
3 - 5 "	309	570	27.2	49.0
6 - 8 "	298	581	27.3	51.8
9 - 11 "	385	689	33.8	59.0
12 - 2 P.M.	269	532	29.9	57.4
3 - 5 "	351	668	37.0	68.1
6 - 8 "	295	565	32.9	61.2
9 - 11 "	358	648	35.0	61.6

*Neonatal Mortality rates per 1,000 live births.
**Rates for combined loss per 1,000 total births (including stillbirths)

OPERATIVE PROCEDURE

The birth certificate in use in New York State outside of New York City does not contain information relative to operative procedure. However, a special certificate for Buffalo City containing such information has been in use for the last two years. Dr. Archibald S. Dean, District State Health Director in charge of the Buffalo District, was kind enough to tabulate the 1937 births by type of delivery and hour of birth. Table 5 was obtained.

A comparison of the column of percentage operative deliveries with the table of stillbirth and neonatal mortality rates by hour of birth (Tables 3 and 4) reveals that the two followed similar trends. The proportion of the deliveries that were operative was considerably higher in the afternoon than

TABLE 5

DISTRIBUTION OF BIRTH BY TYPE OF DELIVERY AND HOUR OF BIRTH, BUFFALO, N.Y., 1937

Hour of Birth	Number of deliveries										Per Cent Operative	Per Cent Forceps-(Low, Mid, and High)
	Total	Normal Spontan.	Low Forceps	Mid Forceps	High Forceps	Version	Cesarean Sec.	Breech	Other Operative	Not Stated		
Total	9,918	6,137	2,089	279	57	574	258	266	88	170	37.0	24.9
12 - 2 A.M.	1,260	809	260	37	10	60	20	33	7	24	34.5	24.8
3 - 5 "	1,280	895	231	27	4	57	9	23	11	23	28.8	20.8
6 - 8 "	1,333	896	262	23	4	60	10	42	9	27	31.4	22.1
9 - 11 "	1,364	748	312	49	9	111	61	41	8	25	44.1	27.6
12 - 2 P.M.	1,171	690	256	42	11	62	45	31	17	17	40.2	26.8
3 - 5 "	1,201	673	268	41	11	88	68	23	14	15	43.3	27.0
6 - 8 "	1,109	696	245	35	4	48	17	32	7	25	35.8	26.2
9 - 11 "	1,200	730	255	25	4	88	28	41	15	14	38.4	23.9

in the morning hours. The peak occurred in this case between 9 and 12 in the morning, but is was only slightly higher than the next highest which occurred between 3 and 6 P.M. The fact that between 9 and 12 A.M. the number of operative deliveries is so high may perhaps be explained by the fact that these are the hours in which most operations are carried out in the hospital. In this connection the relative high numbers of Cesarean sections and version deliveries performed during these morning hours may be noted.

The last column presents the percentage of forceps deliveries only (low, mid, and high) by hour of birth. The pattern is the same as for total operative, and very much like that of the stillbirth and neonatal mortality rates. An inspection of the columns by various types of forceps shows that the greatest variation is presented by mid forceps.

Although these variations are beyond the range that would be expected on the basis of chance alone, it was thought desirable to present a similar table for another locality. This was made possible through the cooperation of Thomas J. Duffield, Registrar of Records of the New York City Department of Health, who was kind enough to tabulate a random sample of some 5000 birth certificates of New York City which contain the information relative to operative procedure. This is presented in Table 6.

TABLE 6

DISTRIBUTION OF BIRTHS BY OPERATIVE PROCEDURE AND BY HOUR OF BIRTH -- 5291 BIRTHS IN NEW YORK CITY, 1937

Hour of Birth	Number of Births						Per Cent Operative Delivered	Per Cent Forceps or Version
	Total	Normal Spont.	Forceps or Version	Cesarean Sec.	Other Operative	Not Stated		
Total	5,291	3,706	1,132	177	27	249	26.5	22.5
12 - 2 A.M.	650	474	133	9	3	31	23.4	21.5
3 - 5 "	730	570	116	9	2	33	18.2	16.6
6 - 8 "	717	544	128	19	1	25	21.4	18.5
9 - 11 "	722	481	141	61	3	36	29.9	20.5
12 - 2 P.M.	597	399	138	23	6	31	29.5	24.4
3 - 5 "	648	419	173	20	7	29	32.3	27.9
6 - 8 "	648	439	159	18	1	31	28.8	25.8
9 - 11 "	579	380	144	18	4	33	30.4	26.4

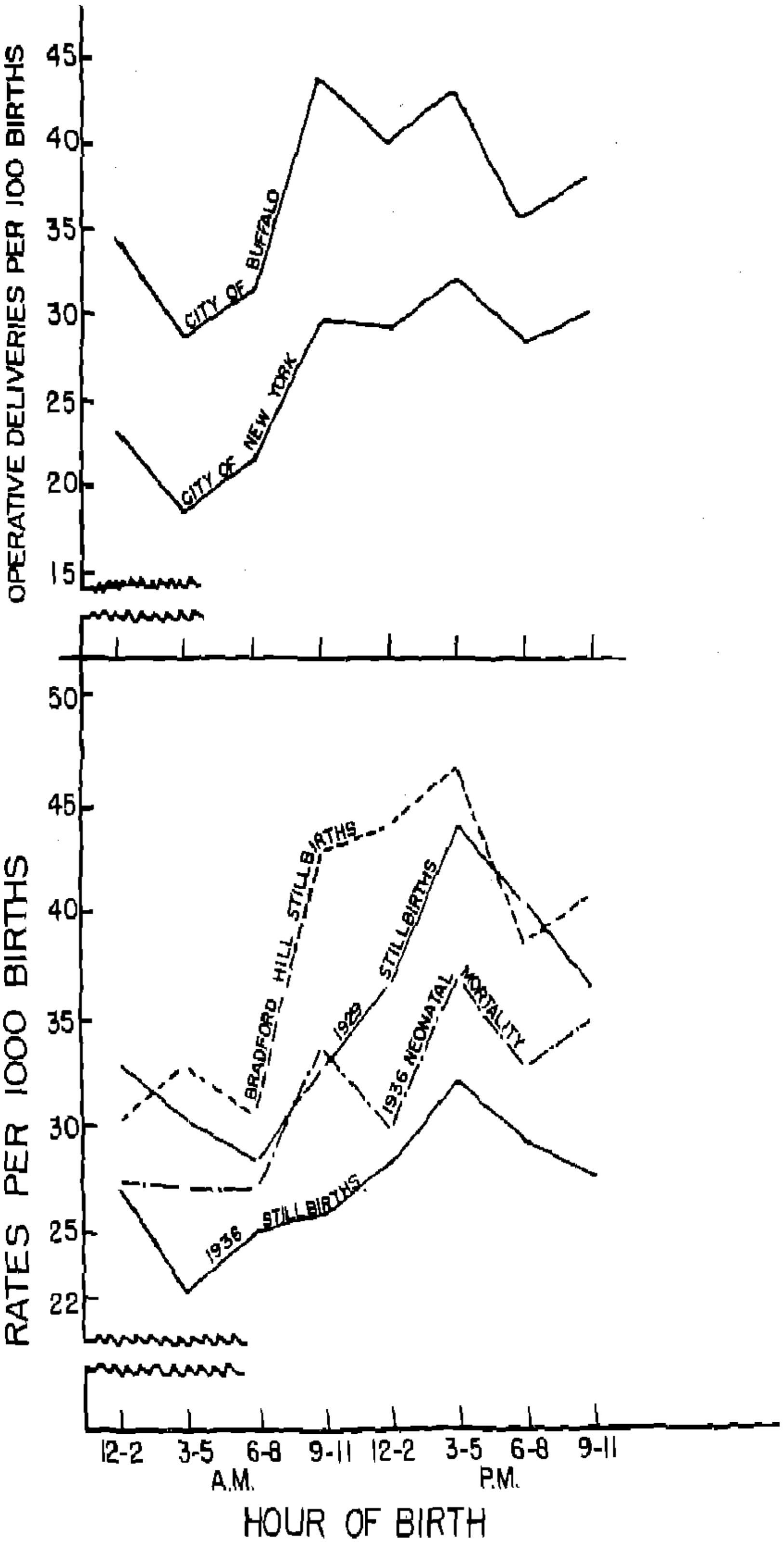

Figure 1. Stillbirth and neonatal mortality rates for New York State, exclusive of New York City, in 1929 and 1936, and stillbirth rates obtained from figures given by Bradford Hill, as well as percentages of operative deliveries for Buffalo and New York City in 1937 by hour of birth.

On the New York City certificate the forceps deliveries were not separated as to kind of forceps. Furthermore, there was no separation of forceps and version, and hence the two are considered together.

Although the percentage of the deliveries that were operative was considerably lower in New York City than in Buffalo, the distribution of the percentages of operative deliveries by hour of birth was very similar in the two cities. The peak in New York City was between 3 and 6 P.M., and the pattern was very similar to the neonatal and stillbirth rates.

For comparison, the rates for stillbirth and neonatal mortality in 1929 and 1936 and those for Bradford Hill's figures, as well as the distribution of the percentages of operative deliveries in Buffalo and New York City by hour of birth, are presented in Figure 1.

SUMMARY

Stillbirths and neonatal mortality rates by hour of birth are presented. The rates were considerably higher for infants born between noon and midnight than for infants born between midnight and noon. The highest rate was found for infants born between 3 and 6 P.M. The percentage of deliveries which were operative was found to follow the same trend. However, it is realized that this correlation does not necessarily imply causal relationship.

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(2) Hill, A. Bradford. Principles of medical statistics. Lancet, London, 1937.

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GROWTH IN SOUTH AFRICAN WHITE BOYS IN INSTITUTIONS: A STUDY OF FIVE DIMENSIONS IN 446 CASES[1]

HARDING le RICHE[2]

In another paper (6) a comparison was made of growth in European and Eurafrican boys in the Tokai Reformatory. It was found that the Europeans exceeded the Eurafricans in nearly all dimensions. This paper should be consulted for further details. As has been mentioned in this previous paper, the physical measurements of the European boys were taken at the suggestion of Dr. L. Fick, Psychologist, National Bureau for Educational and Social Research, and Dr. Felix Brümmer, Technical Advisor, Department of Social Welfare, who are making a study of boys in certain institutions under control of the Union Education Department, from the sociological and psychological points of view. The measurements were taken on 446 boys, aged eleven to twenty-three years, at the Houtpoort Reformatory, Heidelberg, (Tvl), the Emmasdale Industrial School, also at Heidelberg, and at the Tokai Reformatory, Cape Town. The technique of measurement was unfortunately not quite the same for Emmasdale and Houtpoort on the one hand, and Tokai on the other hand. The technique used at Tokai has already been described, (6), and follows the technique of the Iowa Child Welfare Research Station, (7), as closely as practicable. At the other two institutions the boys were weighed clad in a thin pair of short khaki trousers, all heavy objects having been removed from belts and pockets in order to obtain uniformity in the weight of clothing (4). The trousers worn were all of the same type and did not weigh more than 500 g. In the absence of accurate information on the weight of a fairly large number of trousers, a correction has not been made for weight of clothing, the means, standard deviations etc. of the weights in the various age groups in the three institutions being calculated from the weights as they appeared on the questionnaire blanks. As at Tokai, all body measurements were taken on the skin, but as flat callipers accurate to 1 mm. were not available for the Houtpoort and Emmasdale observations, a pair of curved callipers, (pelvimeter) accurate to 5 mm. had to be used, an attempt being made to take the measurements in the positions suggested by the Iowa Research Station. The measurement taken with the pelvimeter was the bi-iliac width, the greatest diameter between lateral lips of the iliac crests, pressure being applied in order to get a bone measurement, as nearly as possible. The technique for the height, sitting height and chest circumference (xiphoid level) were the same for all the boys and is described more fully in the paper already mentioned.

With reference to the racial composition of these boys by far the greater majority of them are of North-West European origin. One would not consider 95 per cent as too high an estimate. Also, in most cases, the parents of these boys were born in this country. It is regretted that detailed accurate information on these questions is not at present available. Another point on which there is unfortunately no information is the extent to which there is an admixture of coloured strains. A few cases were seen who without any doubt had a colored individual (i.e. Cape Coloured, or much more rarely perhaps, Bantu) somewhere in their family tree. But the number of these cases is very small, about 1 per cent. One hopes that the day is not far

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[1] Read at meeting of the South African Association for the Advancement of Science held at Pietermaritzburg, Natal, during July 1938.

[2] From Union Health Department, Pretoria, Union of South Africa. Grateful acknowledgment is made to the S. A. Council for Educational and Social Research for the grant which made this work possible, and to the authorities of the Union Education Department for their kindness in allowing the author to examine the boys at their Institutions.

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off when someone will make a thorough study of the racial composition of the Europeans in South Africa.

One must realize that the cases discussed, are, in the main, drawn from the lower strata of society. This will be brought out much more fully in the sociological and psychological investigations at present being carried out on these same boys. The majority of boys have either been in orphanages most of their lives, or have been deserted by their parents or have been removed from unwholesome environment by the State. One regrets to say that at present quite a number of the Industrial School boys graduate to enter the Reformatories and afterwards the Prisons (3).

The data with which this material is compared have been obtained for American boys from the Iowa Child Welfare Research Station, (0). The German figures are from figures obtained by the Leipzig Health Department (5). An attempt has been made to obtain the latest figures, as evidence from all over the world (Sanders 1930, Koch 1935, Brock 1932) shows that children have been increasing in size; hence the inapplicability of old observations. Growth standards are not static - the human frame is changing, not very much, but the increase in size is very evident to the student of human growth. The American boys are from a rather favoured group. To quote Meredith, "Most apparent is the predominance of the professional class and the insignificant representation of the labouring class. On the basis of the whole table, it seems reasonable to deduct that the data were gathered on a well-nourished group of males.

"In summary, the group on whom the data were taken may be characterized as homogeneous with reference to geographic location and sex, not significantly diverse racially, and somewhat favoured economically and culturally." The German figures are from High School boys, i.e. also from a relatively favoured class. One has purposely selected these standards: the days of minimum growth and nutrition standards are past. We must create an environment in which the children will attain the highest standards of physical well-being possible under their hereditary constitution. The standards mentioned are far from being the optimum. Only the future will show what a favourable milieu can bring about. The German figures are available only for height and weight. Details of somatometric technique are not given. It is assumed that height was measured according to the usual custom, i.e. subject without shoes and stockings, standing against the wall with head in the Frankfort plane. Weights were probably not taken in the nude.

Meredith's technique for taking standing heights is the usual technique, i.e. subject standing with head, heels, buttocks and upper part of back against measuring scale. Head in Frankfort plane, square being brought down firmly on head of subject, whose shoes and stockings have been removed. In taking sitting height the subject sits on a bench 30 or 40 cm. high, thoracic and sacral regions against vertical standard, head in Frankfort plane. Weight was taken on nude subject in kilograms. For further details the original publication (0) should be consulted.

THE MEASUREMENTS

1. Weight.

The weights of the boys are given in Table 1, and on Chart 1 the curves are shown for American and German boys. The age groupings for the American boys are in one-year classes, i.e. 13 years 6 months to 14 years 5 months and 30 days. That is, the midpoint of the interval is 13 years. In my grouping the midpoint of the groups falls on the half-year as the groupings are, e.g. 14 not yet 14, 14 not yet 15 years, etc. for the institution

CHART 1

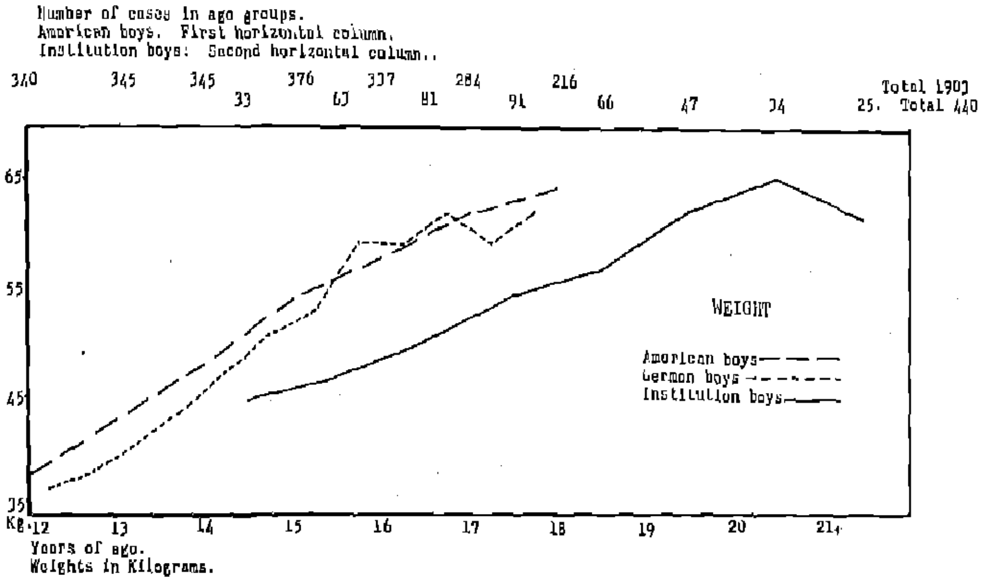


TABLE 1

WEIGHT IN KILOGRAMS

Age Groups	12-	13-	14-	15-	16-	17-	18-	19-	20-	21
Number of cases	1	5	33	63	81	91	66	47	34	25
Mean	44.4	40.8	45.4	47.5	50.7	55.0	57.3	62.8	65.6	62.0
Median			44.79	46.25	51.12	54.95	57.50	63.21	66.38	61.50
S.D.			7.73	8.94	9.33	8.36	8.97	7.75	4.48	5.37
Coeff. of var.			17.02	19.81	18.41	15.21	15.66	12.34	6.83	8.7
S.E.			1.34	1.13	1.04	.88	1.10	1.13	.77	1.07
Range*			27.5- 63.5	30.5- 66.5	33.5- 75.5	30.5- 72.5	33.5- 78.5	39.5- 75.5	54.5- 72.5	51.5- 72.5

*Minimum and maximum values refer to midpoints of highest and lowest class intervals.

boys. The German High School boys are grouped in six-monthly classes, i.e. 13 years to 13-1/2 years, 13-1/2 years to 14 years, etc. The midpoints of these groupings fall therefore at 13-1/4 and 13-3/4 years respectively.

As will be noticed from Chart 1, the American and German boys exceed the institution boys at all ages. The German data are rather irregular in the age groups 15 to 16 and 16 to 17. One would ascribe this phenomenon to the smallness of the number of cases. Unfortunately Koch (5) does not say on how many cases his figures are based.

With the exception of the age groups already mentioned, the American boys exceed the Germans in weight. As the number of cases is fairly large in the institution material, the weight growth curve is fairly regular. It will be noticed from Table 1 that the coefficient of variation is fairly large from ages 14 to 16, falling as the boys get older. This has also been found by Meredith (8), for Iowa boys. It is clear that during adolescence there is far greater variation in weight than for instance in skeletal dimensions. (See Tables 2, 3, 4 and 5 and 6). This is as one would expect; as weight represents the sum total of increase in bulk this value would soonest be effected by changes in the external or internal environment of the organism. The relatively stable skeletal structure would be more resistant to environmental fluctuations. One cannot legitimately conclude from the coefficients of weight variation that the younger boys are in a worse physical condition than the older boys; the weight fluctuations in adolescent boys are probably to a great extent physiologically normal, as sexual maturity is not reached by all the boys at the same ages, and weight changes, due primarily to normal endocrine activity, are spread right through the period of adolescence. As one cannot evaluate the effect of the internal environment on the boys, it is impossible, from the evidence represented above, to state with any degree of certainty whether the boys are, for instance, malnourished or not. Robertson (quoted by Roberts (10)) from a study on California school children, concluded that a defect in stature and weight, with a high variability in stature and a low variability in weight indicated the operation of an unfavourable environment, and that as a criterion of normality, then, variability in stature is a better indicator than variability in weight.

In Table 2 the variabilities of the institution and American boys are shown, for weight and height. It will be noticed that the age groups are not quite comparable as the midpoint of the group in the American data falls on the year, while the institution grouping falls on the half year.

TABLE 2

Midpoint of age groups	Height Coeff. of V.		Weight Coeff. of V.	
	American Boys	Institution Boys	American Boys	Institution Boys
14	8.53		20.4	
14½		5.75		17.02
15	8.63		19.3	
15½		5.86		19.81
16	7.58		16.3	
16½		5.04		18.41
17	6.39		14.9	
17½		4.42		15.21
18	6.25		14.1	
18½		4.75		15.66
19½		4.06		12.34
20½		3.49		6.83
21		4.32		8.7

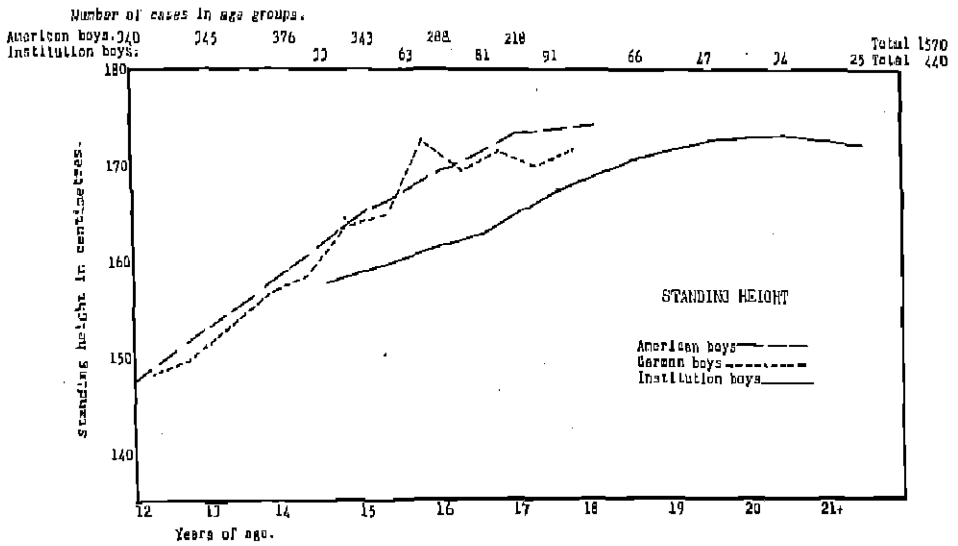
As will be seen from Table 2, the variability of the institution boys for stature is less than that of the American boys, while the coefficient of variation of the weight of the institution boys is slightly more than that of the American boys at 18-1/2 and 17-1/2 years of age respectively.

Assuming the validity of Robertson's criterion, then, the institution boys do not show more signs of the operation of an unfavourable environment than do the American boys, who are from a relatively gently nurtured group.

2. Standing Height.

The information under this heading is summarized in Table 3 and Chart 2. As in the case of weight, the institution boys are inferior to both the American and the German boys, the Americans being superior to the Germans at all ages except in the group 15-16, where the German boys are taller. The curve for the German boys is irregular, probably due to smallness of numbers. The age groupings are the same as mentioned above. Koch (5) in an examination of Leipzig data on school children observes that there has been an

CHART 2



increase in both height and weight in comparable children during twenty years. This phenomenon has been noticed by many workers all over the world, as has already been pointed out in this paper. He then goes on to say that the boys measured during 1932/33 reach their adult stature 1-1/2 years sooner than was the case in similar boys in 1922. One does not question that the boys are taller for their ages than was previously the case, but the evidence in support of the quicker attainment of mature height does not seem conclusive. For one, the number of cases does not seem large enough as the writer himself states: "Die leichte Unruhe der Kurve der höheren Schüler in ihren letzten Halbjahrängen erklärt sich aus der Tatsache, dass naturgemass in diesem Alter nur noch ein relativ geringes Zahlenmaterial zur Verfügung steht. Wenn mithin auch der Einzelwert hierunsicher erscheint, so kann doch an der Tendenz des Verlaufes der Kurve keinerlei Zweifel sein" (P.14).

As it is clear from Chart 2, the curve for the Leipzig boys shows a sudden rise in the age group 15-16 and then again falls. This rise points to fewness in the number of observations made. Assuming that this might be the case in the High School boys, what justification is there for assuming that it applies to the whole population in view of the fact that mentally accelerated children are usually also physically accelerated? ((1), see also (10)). Which would mean that in any case the High School boys would probably be accelerated when compared with the general population of boys. Another point which must be considered is that the High School boys are a highly selected group and not representative of the whole population. Koch's conclusions might be correct in connection with quicker attainment of mature stature, but the evidence he gives in support of his statement is not conclusive. The institution boys appear to reach their mature stature between 20 and 21 years, which is the usual age. The Tokai material (6) also seems to indicate a quicker attainment of mature stature, but utilizing all the available data for institution boys, the evidence suggests that this assumption is erroneous.

3. Sitting Height.

The data on the sitting height are shown in Table 4. In general this curve resembles that of bi-iliac width, which is shown in Chart 3. It will be noticed that the variability of the sitting height decreases as the age increases. This is also the case for standing height. It was not considered necessary to include a curve of sitting height.

TABLE 3

STANDING HEIGHT IN CENTIMETRES

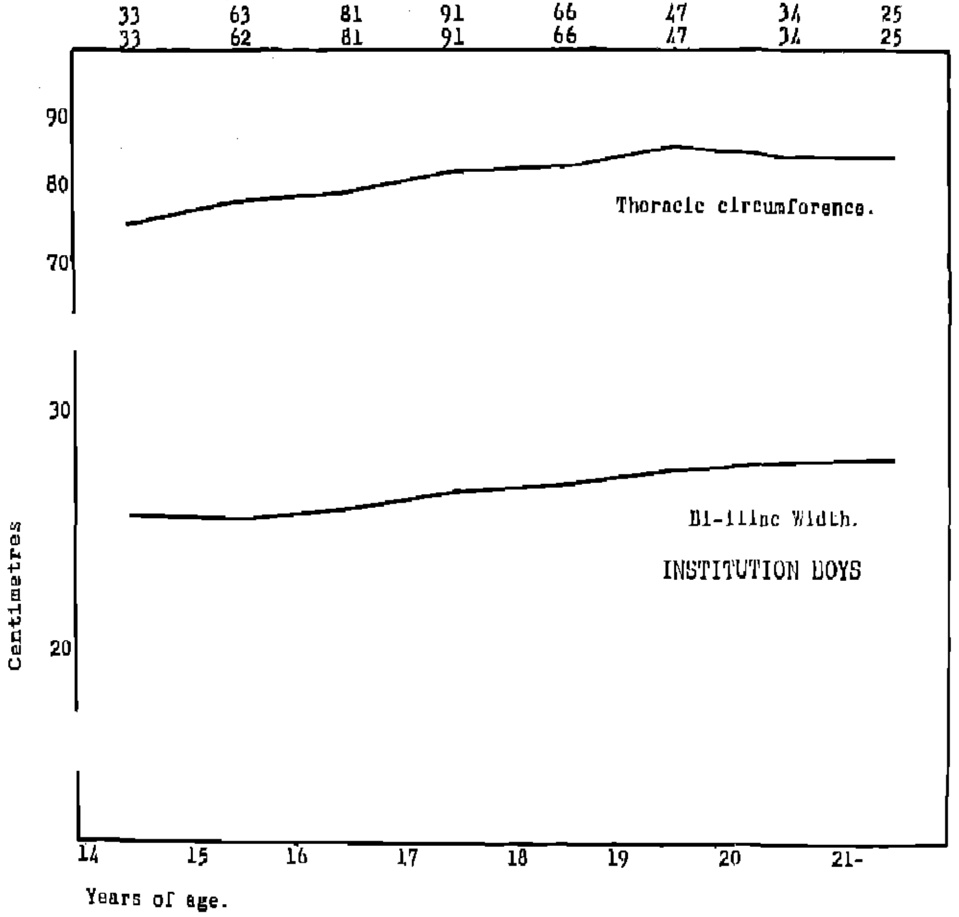
Age Groups	12-	13-	14-	15-	16-	17-	18-	19-	20-	21-
Number of cases	1	5	33	63	81	91	66	47	34	25
Mean	160	153.7	157.7	160.3	162.8	167.3	170.8	172.9	173.1	172.0
Median			158.80	161.56	164.55	168.61	168.0	173.50	168.00	173.56
S.D.			9.08	9.39	8.20	7.39	8.12	7.02	6.04	7.43
Coeff. of Var.			5.75	5.86	5.04	4.42	4.75	4.06	3.49	4.32
S.E.			1.58	1.18	.91	.77	1.00	1.02	1.04	1.49
Range*			138- 178	138- 182	146- 178	150- 182	150- 186	154- 186	162- 186	154- 186

*Minimum and maximum values refer to midpoints of highest and lowest class intervals.

CHART 3

NUMBER of CASES in each AGE GROUP

Thoracic Circumference: First horizontal column..
Bi-iliac Width: Second horizontal column..



Graph drawn on Arithlog paper.

TABLE 4

SITTING HEIGHT IN CENTIMETRES

Age Groups	12-	13-	14-	15-	16-	17-	18-	19-	20-	21*
Number of cases	1	5	33	63	80	91	64	46	34	25
Mean	77.5	76.2	80.3	81.1	82.6	85.3	85.5	88.6	89.2	89.2
Median			79.71	81.80	89.91	85.55	86.27	88.67	87.67	89.29
S.D.			5.12	5.03	4.93	3.96	4.72	3.40	3.34	3.12
Coeff. of Var.			6.38	6.20	5.97	4.65	5.52	3.84	3.74	3.50
S.E.			.91	.63	.55	.42	.59	.50	.57	.62
Range*			68.5- 90.5	68.5- 90.5	72.5- 92.5	74.5- 92.5	74.5- 94.5	78.5- 96.5	78.5- 94.5	80.5- 94.5

*Minimum and maximum values refer to midpoints of highest and lowest class intervals.

4. Normal Chest Circumference.

The chest circumference was taken at the xiphoid level and therefore not comparable with the Iowa data (8) which was taken at the nipple level.

The data are given in Table 5 and the curve is drawn on arithlog graph paper. (9, p. 184). As is shown, the thoracic circumference increases regularly up to the age of 19-1/2, when the nature size seems to be reached. The variation is irregular from age to age.

TABLE 5

NORMAL CHEST CIRCUMFERENCE (XIPHOID LEVEL) IN CM.

Age Groups	12-	13-	14-	15-	16-	17-	18-	19-	20-	21*
Number of cases	1	5	33	63	81	91	66	47	34	25
Mean	73.5	71	74.2	77.5	78.7	81.7	82.1	85.1	83.8	84.4
S.D.			4.23	5.22	5.67	4.51	5.17	4.56	2.99	4.13
Coeff. of Var.			5.56	6.74	7.20	5.53	6.30	5.35	3.57	4.89
S.E.			.74	.66	.63	.47	.64	.66	.51	.83
Range*			64.5- 82.5	66.5- 88.5	64.5- 92.5	64.5- 92.5	68.5- 96.5	74.5- 96.5	80.5- 94.5	74.5- 92.5

*Minimum and maximum values refer to midpoints of highest and lowest class intervals.

5. The Bi-iliac Width.

The bi-iliac width is presented in Table 6 and is graphically shown on Chart 3. This diameter increases regularly and does not show the slight increase which is shown by the thoracic circumference at the age of 19-1/2; unfortunately Meredith (8) does not give bi-iliac width in his study.

The main object of this paper has been to place on record the data obtained from the Institution boys, in view of the great lack of somatometric and other physiological and anatomical information on healthy South African white children. One hopes that much more of this work will be carried out on children in South Africa, whether they be white, black or yellow.

TABLE 6

BI-ILIAC WIDTH IN CENTIMETERS

Age Groups	12-	13-	14-	15-	16-	17-	18-	19-	20-	21*
Number of cases	1	5	33	62	81	91	66	47	34	25
Mean	24.5	24.5	25.3	25.1	25.8	26.5	26.9	27.5	27.9	28.0
Median			25.07	25.5	26.04	26.92	27.33	27.72	28.20	27.94
S.D.			1.74	1.73	1.68	1.77	2.09	1.60	1.96	1.41
Coeff. of Var.			6.88	6.88	6.50	6.66	7.72	5.81	7.02	5.02
S.E.			.30	.22	.19	.19	.26	.23	.34	.28
Range*			22.5- 29.5	21.5- 29.5	22.5- 29.5	21.5- 30.5	20.5- 31.5	21.5- 30.5	20.5- 31.5	25.5- 30.5

*Minimum and maximum values refer to midpoints of highest and lowest class intervals in groupings.

SUMMARY

1. Data are presented for measurements of weight, height, sitting height, thoracic circumference and bi-iliac diameter taken on 446 Institution boys aged 12 to 23 years.

2. Compared with certain American and German data these boys are inferior in weight and height.

3. The relation of weight and height to environment is briefly discussed.

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